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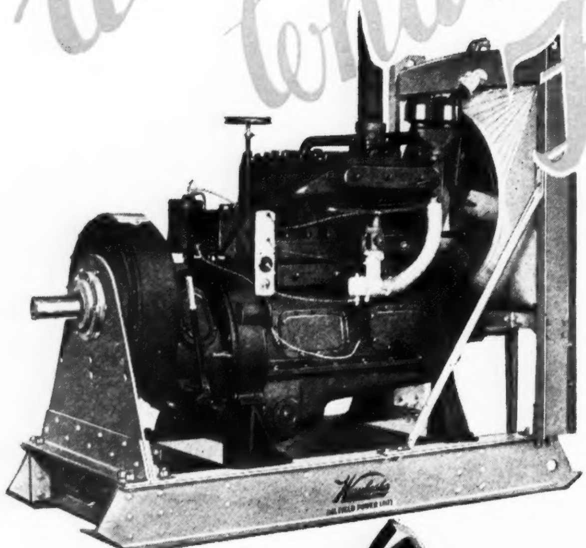

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AUTOMOTIVE INDUSTRIES

VOLUME 56 — *Philadelphia, Saturday, June 4, 1927* — NUMBER 22

Improving Car Performance—
Question is Not "HOW" *but* "CAN" *it be Done?*

An analysis of the effect of engine size on maximum speed, acceleration and economy.

By DR. WILLIAM S. JAMES

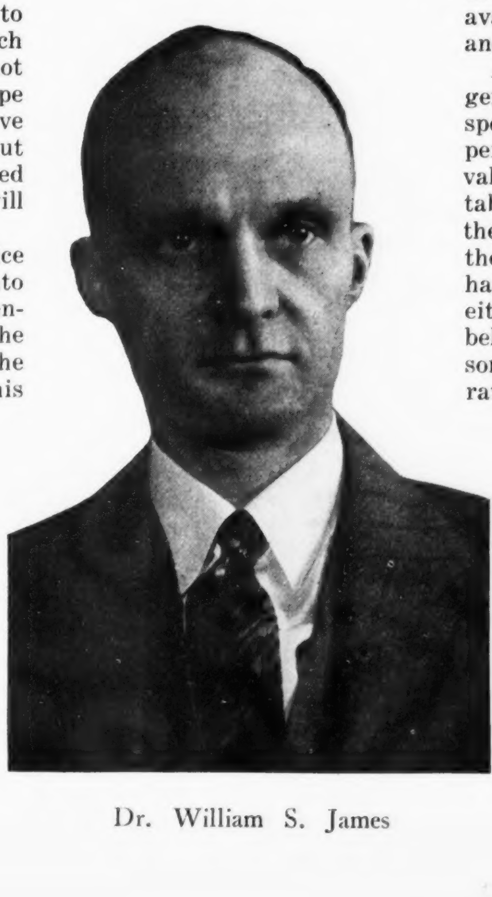
Head, Research Dept., Studebaker Corp. of America

FACES most familiar are the hardest to describe and engineering relations which ahe encountered daily are frequently the most difficult to visualize clearly. No apology is offered, therefore, for the fact that the material here presented lacks novelty.

The purpose is not to point out the unusual but rather to call attention to certain major considerations which must receive attention if time is not to be frittered away in the vain hope that detail improvements will remove basic difficulties. Details are vital but a 22-calibre bullet, though constructed with infinite attention to detail, will never stop a charging elephant.

An engine is essentially a device for transforming gas pressure into mechanical torque. In the conventional internal combustion engine the pressure is produced by raising the temperature of a volume of gas, this being accomplished by the combustion of some hydrocarbon. The indicated mean effective pressure, as its name implies, is the average working pressure in the cylinder and with constant combustion efficiency is proportional to the weight of air breathed by the engine.

A certain amount of energy is expended in transforming the energy in the high temperature gases into mechanical torque. This energy is made up of mechanical friction and gaseous friction and the sum of these two may conveniently be expressed as friction mean effective pressure. It should be noted that both indicated and friction mean effective pressures are independent of cylinder size. It is the difference between the *indicated* mean effective pressure and the *friction* mean effective pressure which is available for overcoming the resistance encountered in driving the car.

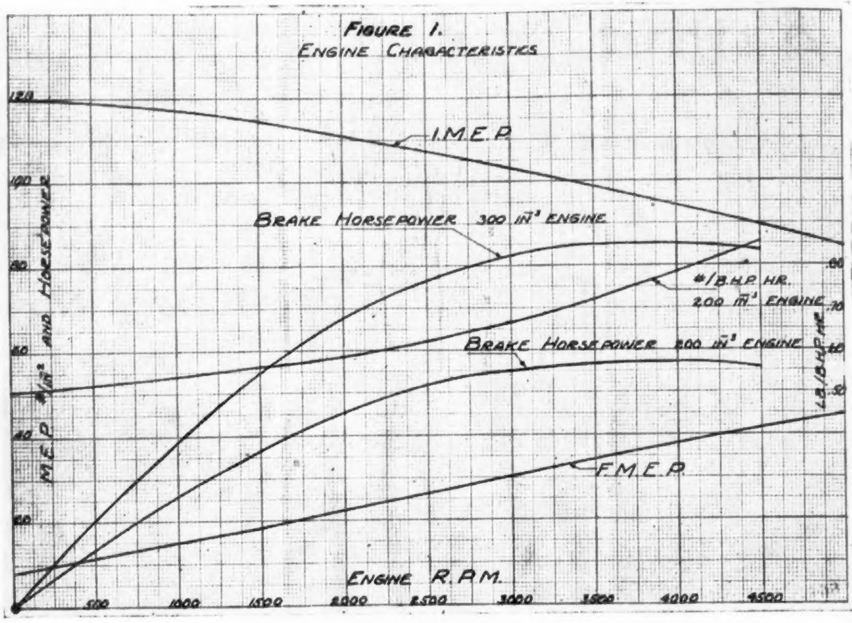


Dr. William S. James

As a starting point in outlining the general relations between engine speed, piston displacement and car performance, it is necessary to select values for these quantities and to establish reasonable relations between them and the speed of the engine and the car. The assumptions which have been made in this connection either have been established or are believed to be reasonable, although in some instances they represent ideal rather than actual engine performance.

It has been assumed: (1) that the indicated mean effective pressure is directly proportional to the weight of air taken into the cylinder; (2) that the weight of the cylinder charge varies with (a) the manifold pressure and (b) the cylinder volume remaining after the gases in the clearance volume are expanded to the manifold pressure; (3) that the fuel consumption in pounds per indicated horsepower hour is independent of speed and load, and

that the friction mean effective pressure can be considered as made up of three factors—(a) a frictional force which is independent of engine speed, (b) a frictional force which increases linearly with speed and (c) a gas frictional force which pumps the cylinder charge from the pressure in the manifold to atmospheric pressure (considering the cylinder as a single stage air compressor with a compression ratio equal to the engine compression ratio). These are assumptions which have been found to be consistent with experimental data obtained from several engines of different cylinder size.



For the purpose of calculation, numerical values have been assumed as follows:

(1) Maximum Indicated Mean Effective Pressure = 120 lb. per sq. in.

(2) Indicated Mean Effective Pressure varies with engine speed in accordance with the following relation:

$$(I.M.E.P.)_N = \frac{P_m}{P_a}\left[\frac{D}{C_l} - \left(\frac{P_a}{P_m}\right)^{\frac{1}{s}}\right]\frac{1}{\left[\frac{D}{C_l} - 1\right]}(I.M.E.P.)_{Max.}$$

$$= \frac{1}{1-KN^2}\,\frac{\left[\frac{D}{C_l} - \left(\frac{P_a}{P_m}\right)^{\frac{1}{s}}\right]}{\left[\frac{D}{C_l} - 1\right]}(I.M.E.P.)_{Max.}$$

$(I.M.E.P.)_N$ = I.M.E.P. at N. r.p.m.
P_m = Manifold Pressure.
P_a = Atmospheric Pressure.
K = an experimental constant.
N = revolutions per minute.
D = Total Piston Displacement.
C_l = Clearance volume.
s = Adiabatic Expansion Exponent.

For the assumed conditions:

$$(I.M.E.P.)_N = \frac{120}{1-14 \times 10^{-9}\,N^2}\;\frac{3.55-(1-14 \times 10^{-9}\,N^2)^{0.77}}{2.55}$$

(3) Friction mean effective pressure varies with the engine speed as follows:

$$(F.M.E.P.) = 8.5 + 0.0063\,N + 54\,\frac{P_m}{P_a}\left[\frac{D}{C_l} - \left(\frac{P_a}{P_m}\right)^{\frac{1}{s}}\right]\left[\left(\frac{P_a}{P_m}\right)^{\frac{s-1}{s}} - 1\right]$$

(4) Fuel consumption has been assumed to be 0.47 pounds per indicated horsepower hour which for ordinary gasoline is equivalent to an indicated thermal efficiency of 30 per cent.

(5) The car was assumed to have the following characteristics:

(a) Weight—3500 lb.
(b) Rolling Resistance—10 lb. per 1000 lb. of car weight.
(c) Frontal Area—24 sq. ft.
(d) Wind Coefficient—0.0022.
(e) Rolling Radius of wheel—15 in.

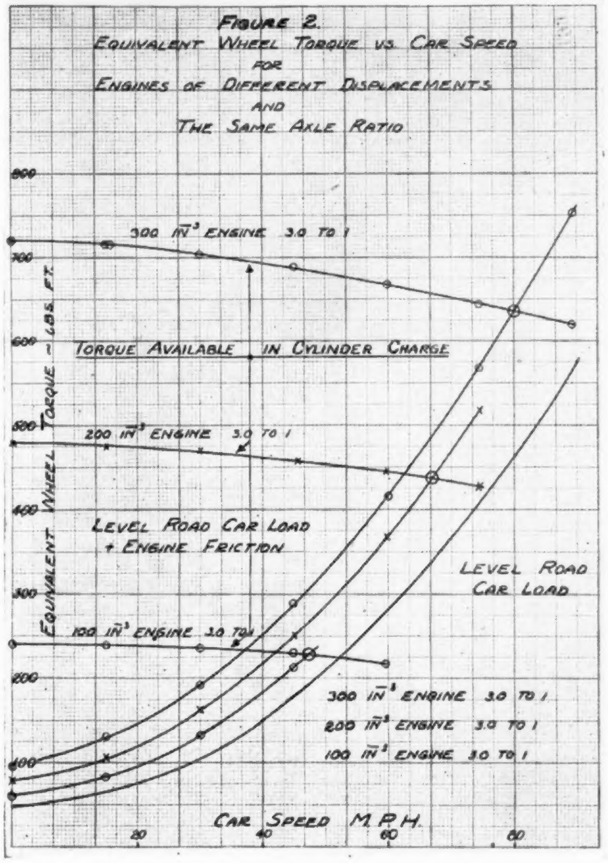
No change in car weight with change in engine size was assumed.

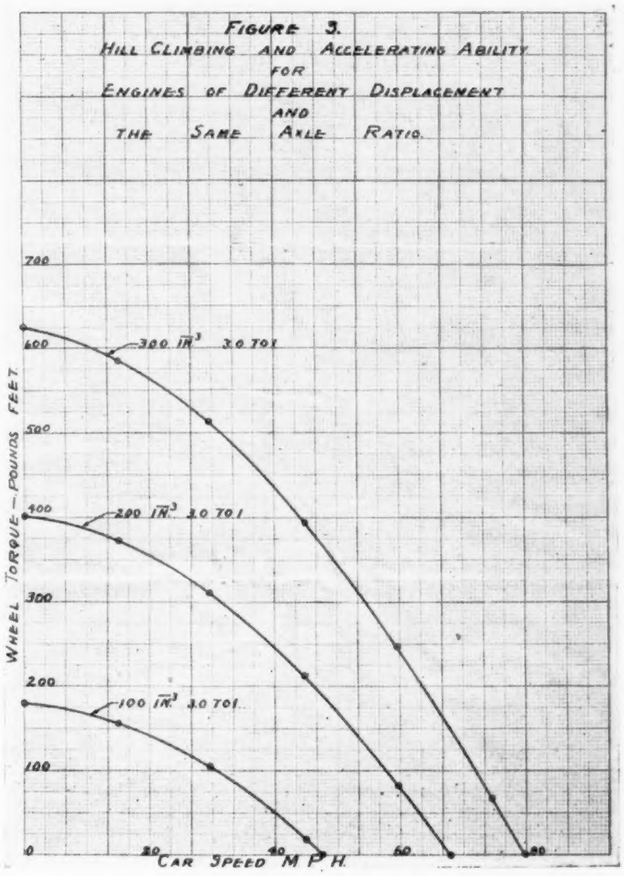
The Author

MR. JAMES' extensive investigations of fuel and engine problems have made him an outstanding figure in his field. He is probably best known for his work with the Bureau of Standards, where he began a series of notable engine and fuel tests in the Automotive Power Plant Section in 1917, after gaining his degree as mechanical engineer from Washington University.

After serving as chief of the Automotive Power Plant Section from 1922 to 1924, he spent two years as technologist for a prominent oil company in California before assuming his present duties as head of the Studebaker research work.

Mr. James is a Fellow of the American Physical Society and a member of the Society of Automotive Engineers, the National Academy of Sciences and the American Society for Testing Materials.





For the assumed car the rolling resistance would be

$$\frac{3500}{1000} \times 10 = 35$$

and the wind resistance would be

$$0.0022\ AV^2 = 0.0022\ (24)\ V^2$$

The variation in wheel torque in pounds feet with speeds in miles per hour would then be

$$wheel\ torque = 43.7 + 0.065\ V^2$$

where V = speed in miles per hour.

It has been mentioned that the assumptions are not dependent upon engine size. Car performance, however, depends very much upon engine size and the figures are intended to point out to some extent that dependence.

Thus Fig. 1 shows the major characteristics of hypothetical engines. In an actual engine the indicated mean effective pressure usually falls off at speeds below 500 r.p.m. because of gas leaks and other effects. Differences in performance at speeds below 500 r.p.m. are not stressed in this paper, however, and the departure of the actual from the ideal condition is of no particular importance.

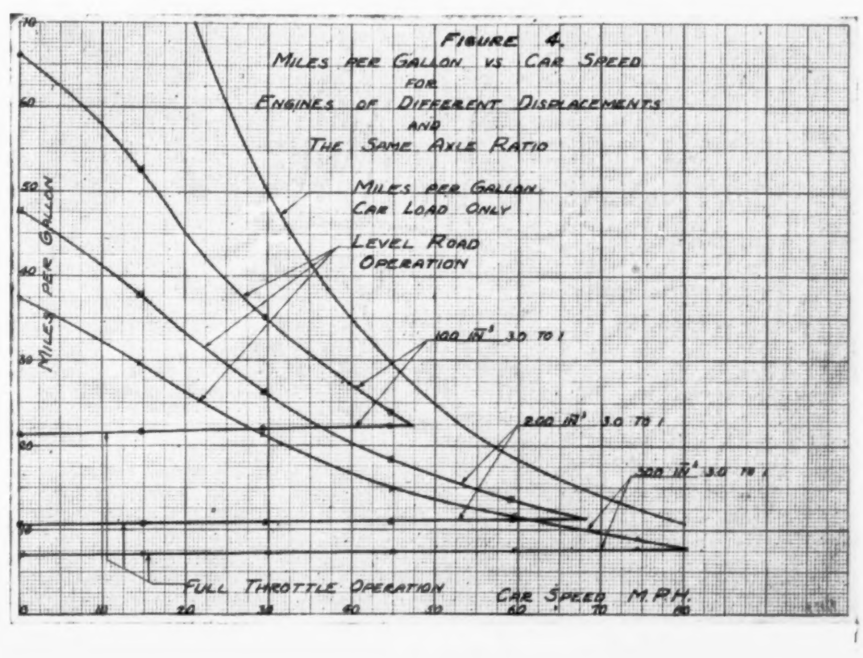
In outlining the results to be expected from changes in piston displacement and engine speed three general conditions have been selected.

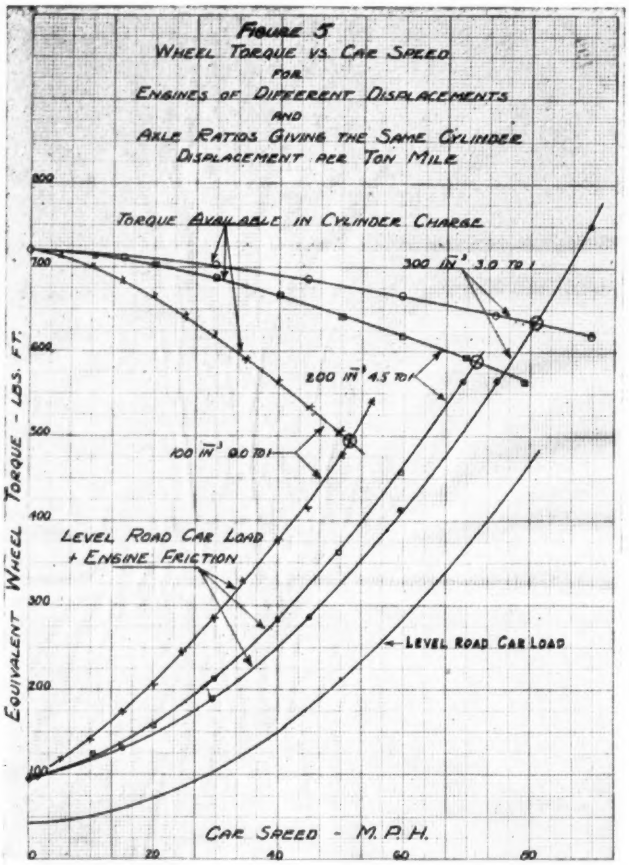
First: Three engines of different displacement (100 cu. in., 200 cu. in. and 300 cu. in.) with the same axle ratio, 3.0 to 1.

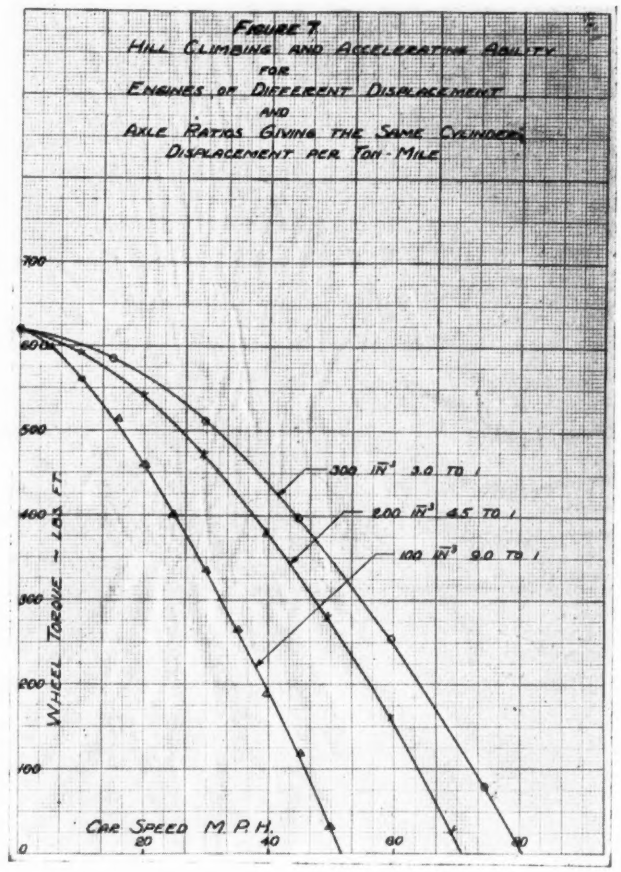
Second: Three engines of different displacement (100 cu. in., 200 cu. in., and 300 cu. in. with axle ratios of 9.0 to 1, 4.5 to 1 and 3.0 to 1 respectively). These combinations all give the same piston displacement per ton mile.

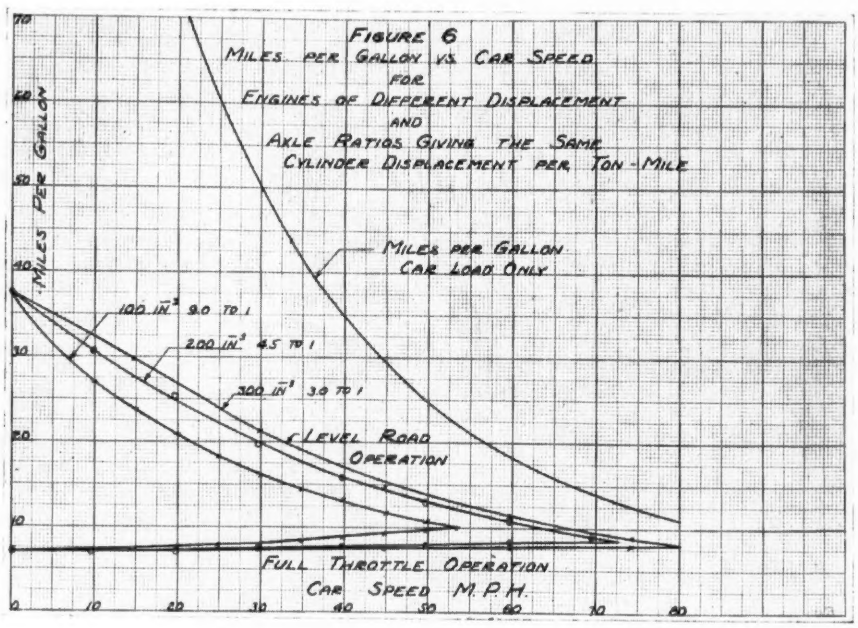
Third: A single engine of 200 cu. in. displacement with axle ratios of 5.0 to 1, 4.5 to 1, 4.0 to 1, 3.5 to 1 and 3.0 to 1.

For all three comparisons the hill climbing and accelerating ability, miles per gallon of fuel, and maximum speed have been plotted. For these plots the indicated and full throttle mean effective pressures have







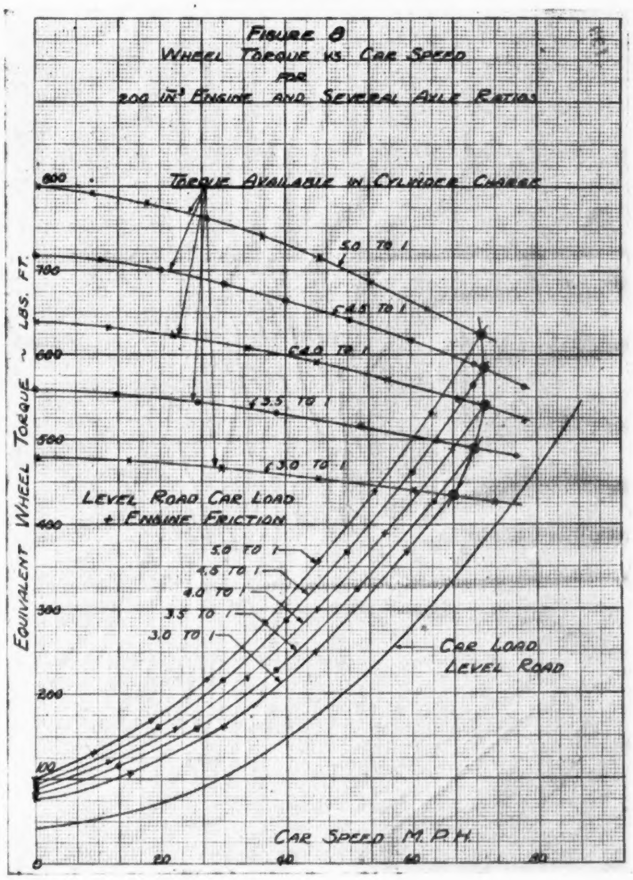


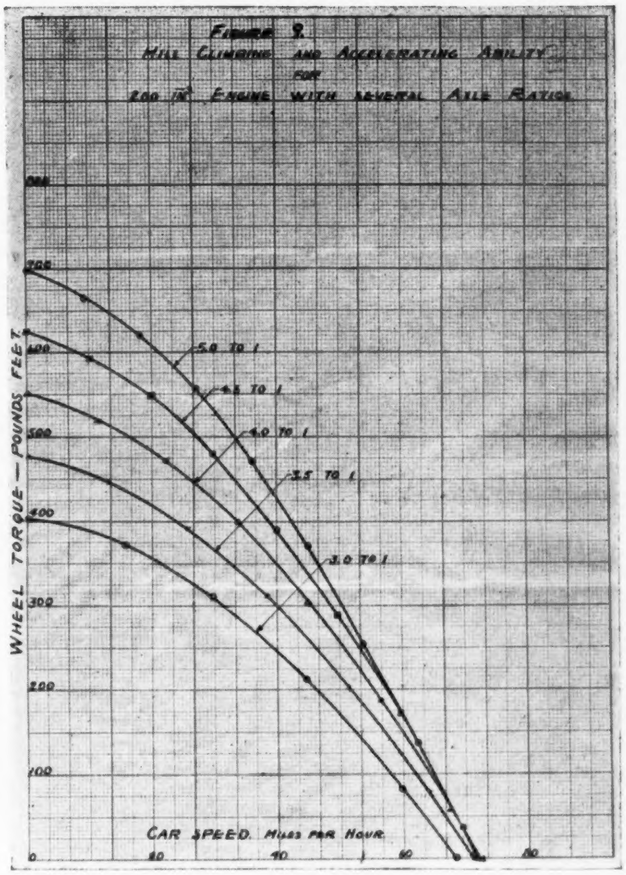
been translated into wheel torque. The intersection of the curve of "wheel torque equivalent to the indicated mean effective pressure" and the curve representing the sum of the car load and full throttle engine friction is taken as the maximum car speed on a level road. The difference between these two curves represents hill climbing and accelerating ability.

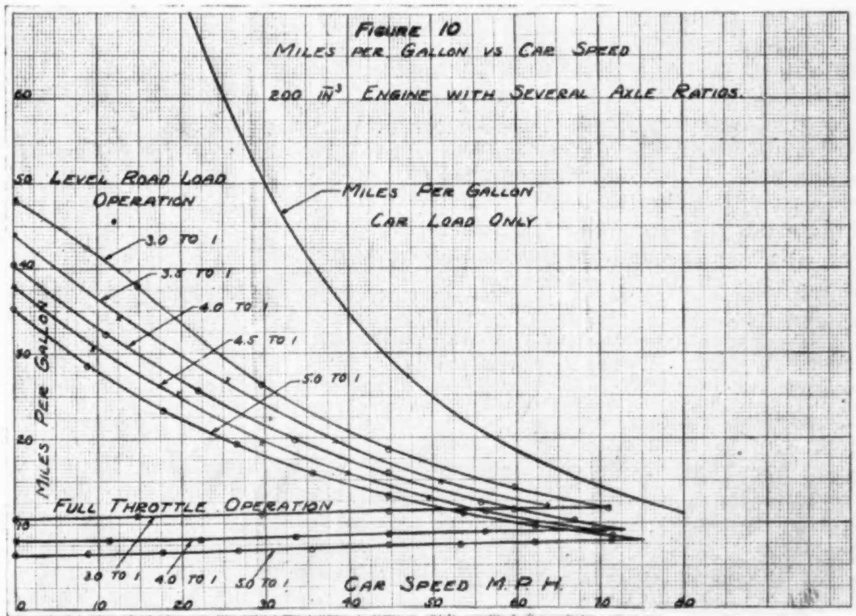
It will be noticed that the engine friction is added to the car load instead of being substracted from the indicated cylinder torque as is ordinarily done. Plotting the results in this way has the advantage of making easier a comparison of the relative amounts of energy required to drive the engine and the car. Figs. 2, 5 and 8 show these values for the three comparisons selected.

Relative hill climbing and accelerating ability is shown in Figs. 3, 6 and 9.

The gasoline mileage for the three conditions is shown in Figs. 4, 7 and 10. As a matter of interest there is plotted also the gasoline mileage which would be obtained if the engine friction were zero. This curve emphasizes the fact that the large decrease in mileage with increase in car speed is not due primarily to mechanical or combustion efficiency but rather to the increase in power required to propel the car at high speeds. The





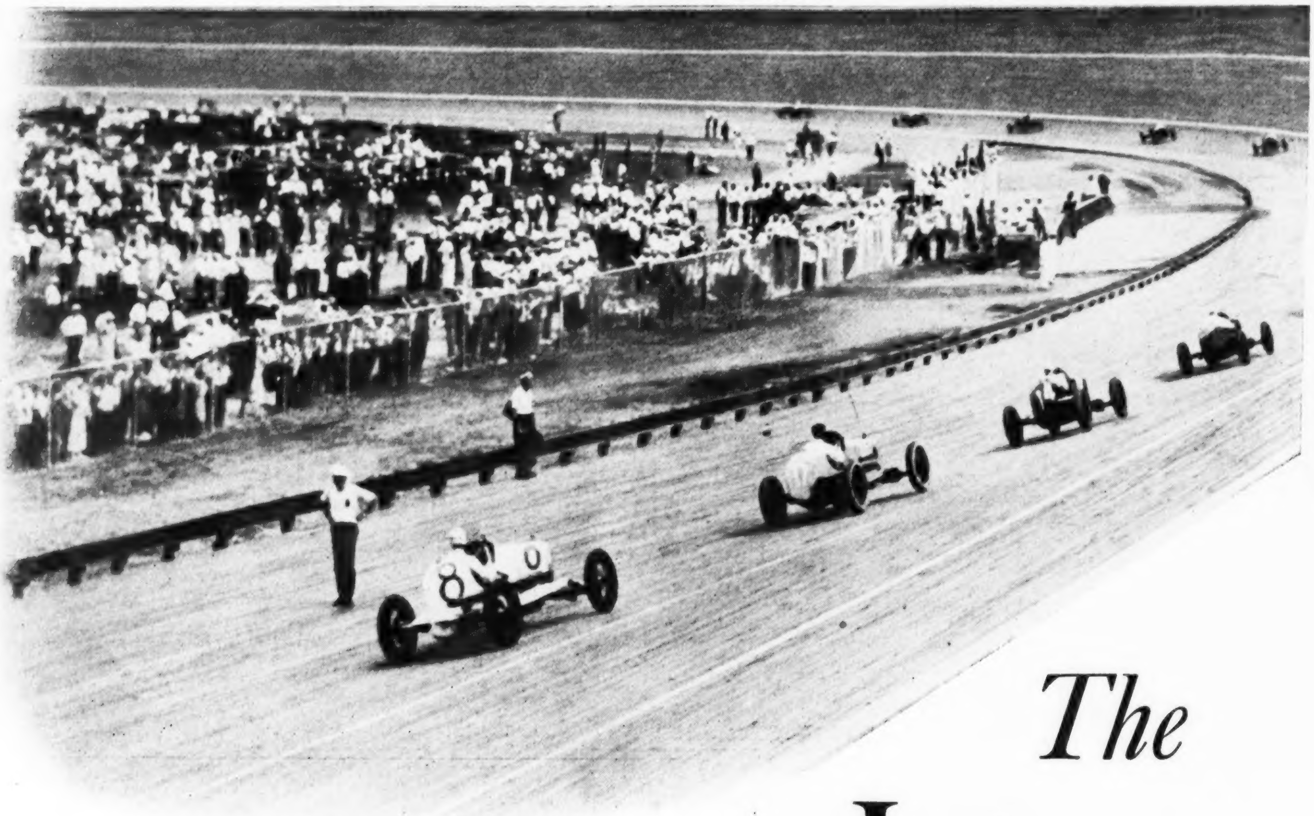


engine friction when driving the car on a level road is greater than when operating at full throttle by an amount equal to the increased pumping loss. This pumping loss has been calculated in the same manner as that at full load, namely, by obtaining a manifold depression and cylinder charge capacity such that the sum of the road load, the engine friction and the pumping loss is equal to the indicated mean effective pressure with that manifold depression and cylinder charge capacity.

On all the curves the points indicate differences of 500 r.p.m. in the engine speed. For example, in Fig. 5 the maximum car speed with the 300 cu. in. engine and the 3.0 to 1 axle ratio is reached at about 2700 r.p.m., whereas the maximum car speed with the 100 cu. in. engine is reached at about 5300 r.p.m.

It must not be forgot that these curves indicate only what can be accomplished and do not give information as to the difficulties which may attend such accomplishment. Vibration, noise, life and the like must all receive consideration. Nevertheless, as we pointed out in the beginning, it is folly to attempt to answer the question "*How* can it be done?" until an affirmative answer has been obtained to the question "*Can* it be done?"

This paper's sole aim has been to assist in answering the latter question.



The Influence Stock Car

Automotive engineers have of gruelling races

IN the earlier days of this industry, the pioneer builders of motor cars took a great deal of interest in racing, particularly in the stock car events. Such men as Henry Ford, Alexander Winton and many others spent a great deal of their time on the track. They early recognized the necessity for some sort of accelerated test to determine the strength of materials they contemplated using, and as they had very little background in pioneering this new art they were compelled to cut and try to the extreme limit.

The reasons men of this type favored these contests in the earlier days were twofold: First, to check up their designs, and second, to give broad publicity to their new and strange product.

The American mind, while always receptive to any epoch-making invention, had to be thoroughly sold on the automobile before accepting and utilizing it to the fullest extent. Racing in the early days served to interest capital in promoting the venture and then to attract the attention of the newspaper and magazine men by thrilling them with speed contests the like of which had never before been witnessed. So we may say that we succeeded to a remarkable extent in the earlier days by the above methods.

Earlier Glamor Faded

The glamor of the race track gradually faded away, however, because nothing very new was offered from the sporting angle and after the manufacturers got into production they seemed to be too busy to pay any serious attention to racing. Now we witness the peculiar situation of the earlier devotees of racing completely ignoring it.

Augmenting the race track events in the earlier stages of our industry, we had the Glidden tours, a type of endurance test which became very popular, particularly with car owners. These tours were very useful in their day for determining the relative reliability of certain types of cars. The event, however, in time became very unwieldy on account of the large number of entries and the difficulty in controlling traffic. Finally it was abandoned. Nevertheless, contests of this sort would probably again prove very useful to our industry.

If a tour of this sort were again to be staged it might have to cover the entire country with a route stretching from the Atlantic to the Pacific Coast. Many difficulties would be encountered with the local authorities en route of course, but that would be a problem for the officials of the American Automobile Association to work out.

The advantage of this type of test or endurance run is that the contestant actually encounters every type of road condition that is normally met with in his regular use of the car.

There are many groups in our industry bitterly opposed to using in actual track racing cars built exclusively for transportation purposes. These groups claim that if a car is to compete successfully in these races

To me the race track furnishes great engineering possibilities; great mechanical truths are so impressively driven home in an interesting and thrilling environment. —Thomas J. Litle, Jr.

MR. LITLE, the author of this article, is chief engineer of the Marmon Motor Car Co. and director of the Technical Committee, Contest Board, American Automobile Association, the latter office bringing him in direct contact with racing. He served during 1926 as president of the Society of Automotive Engineers.

Mr. Litle entered the automotive field in 1917 when he joined the engineering department of the Cadillac Motor Car Co. Previous to this he had done important development work in the gas-lamp and gaseous combustion fields and was chief engineer of the Welsbach Light Co., Gloucester City, N. J. After advancing to the position of research and experimental engineer at Cadillac, he left that company in 1918 to go with the Lincoln Motor Co., of which he eventually became chief engineer. He joined the Copeland Products Co. in 1926 as vice-president and director of engineering, but resigned later in the year to accept the position he now holds with Marmon.

of *Racing* on Future Design

By THOMAS J. LITLE, JR.

much to gain by observation on nation's speedways

it will have to be considerably modified in design, making it closer resemble racing cars.

Another type of race which was very successful in years gone by was the Vanderbilt Cup Race. Here again normal operating conditions were somewhat more nearly simulated by using regular roads for the cars. There is no question but that this type of race brought out many interesting new designs and if a revival of this form of road race could be effected the industry might gain much.

A similar type of race was run for many years in Fairmount Park in Philadelphia, and while the course was not so long it was circuitous and contained hills, sharp turns and buried paving. In this instance, as well, there was a distinct public interest in cars which were able to compete successfully, because conditions were so similar to those actually met with by the owners of the early automobiles.

The great value of the race track, as I see it today, is in developing better structures that will withstand the grueling grind of the contest, even though racing cars are built differently from stock passenger cars, and the engineer who is wise will study with very great care the conditions under which these cars are compelled to operate.

In tests made on the Indianapolis Speedway, which is paved with brick, it has been frequently observed that more parts failures occur than when driving over similar distances on either a board or a dirt track.

13,000,000 Vibrations a Day

For this reason a track of this type is particularly useful in checking up the manufacturer's product from an endurance standpoint. For instance, in making one lap of this track a car must pass over 50,000 joints or grooves between bricks and in the course of a day something over 13,000,000 vibrations can be set up in the entire structure in consequence. It is therefore apparent that if high speeds are maintained over such a course for a prolonged period, parts may be fatigued to an extent never encountered on the smoother road surfaces. For this reason I have a decided preference for this type of track for testing purposes. Any manufacturer can send a car to be tested—and several manufacturers do this very thing—over this Indianapolis track and thus test their product to their own satisfaction.

In serving on technical committees at contests, I have observed many interesting failures in material or at-

tachments, such as the tearing loose of the fuel tank supports, the breaking of shock absorbers and in one case the breaking of a steering arm.

At one test, it was interesting to note that with cars of identically the same make, merely varying in body weight, the lighter body was very much easier on tires.

It is a very impressive sight to witness the rubber tread entirely ground off of a tire exposing the canvas carcass in a very few hours. It is equally interesting to note how much trouble can be encountered from water in the gasoline supply as well as the large amount of foreign material that may be taken from the filtering sumps of a gas line in a single day.

Elimination of Weak Points

In the past, I believe, many accidents have occurred due to failures in material which in ordinary factory testing would not show up. That is another reason why accelerated and severe road endurance runs are desirable. We read of many accidents occurring on the highways where fatalities occur, but there is always an element of uncertainty as to the direct cause. The advantage to the engineer of testing any device to destruction is to enable him to visualize accurately the future operation of his company's product, and apply a sensible safety factor to his design, not going to extremes of weight to obtain strength nor skimping his design to obtain lightness.

The proving grounds, which are being erected at different points by various companies, are virtually private race courses providing facilities which it would be difficult to obtain by the use of public roads. Most companies admit that ordinary road testing is inadequate, because of the heavy present-day traffic and the liability of clashing with state authorities in conducting tests on the open road. We find, therefore, some companies actually utilizing the race course for the final testing of their product.

In Period of Transition

Whether or not stock car contests will be successfully staged in this country is a moot question, but I believe that much is to be gained by a closer observation of such non-stock car races as those held yearly at Indianapolis, where such wonderful results have been obtained from small displacement motors. Some engineers claim that these miniature motors do not now represent, and probably never will, a practical structure for passenger car work, but I differ with them in this regard. I believe that at the present time we are in a state of transition and that our powerplants will be decreased in dimension and weight, and increased in power. We certainly passed through a period of hectic production where we had difficulty in supplying the public demand for transportation and have arrived at a point where refinement and the introduction of new ideas is almost imperative to the continuance of our prosperity.

The influence of the race track is very marked in engine design. It does not, of course, necessarily follow that all of the features of the racing car could be successfully adapted to passenger car work but such radical improvements affecting performance as the adoption of the supercharger and the more perfect balance of parts will shortly be announced in the passenger car field.

We encounter a number of nice problems, of course, but whenever there is a strong demand for mechanical improvement, American ingenuity may be depended upon to meet it. It must surely occur to every interested engineer that the small-displacement, supercharged, high-speed motor will sooner or later enter the passenger car field.

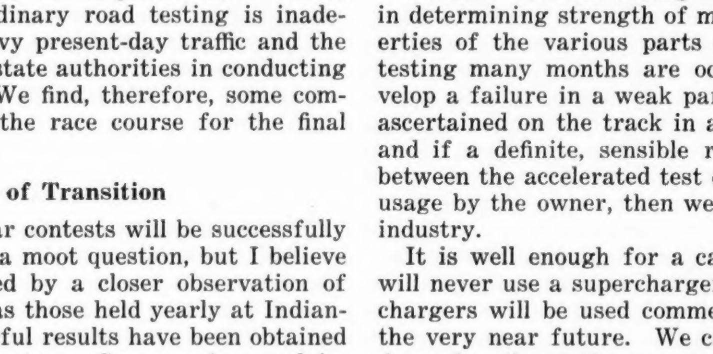
A recent announcement that a speed of 172 miles per hour was obtained on a car equipped with a 91½ cu. in. displacement motor proves beyond doubt that the American engineer can gain much by a close study of racing car designs. I would strongly recommend that on the occasion of great races the various companies detail their engineers to study closely these problems. Some of the important parts of our structures will have to be strengthened and the physical properties of materials increased to meet the grueling test of the race track, but we have not yet by any means exhausted the possibilities of the use of better steel alloys and chromium coatings. To me the race track furnishes great engineering possibilities; great mechanical truths are so impressively driven home in an interesting and thrilling environment.

Value of Contests

Contests between racing cars are extremely valuable in determining strength of materials and physical properties of the various parts of chassis, for in regular testing many months are occasionally required to develop a failure in a weak part which can be frequently ascertained on the track in a comparatively few hours, and if a definite, sensible relation can be established between the accelerated test on a race track and normal usage by the owner, then we have gained much for the industry.

It is well enough for a car engineer to say that he will never use a supercharger, but I predict that superchargers will be used commercially and successfully in the very near future. We can all of us remember the days when the stationary gas engine producing 10 horsepower was a ponderous affair copied in design more or less after the steam engine with its single cylinder and enormous flywheel, and just as we have modified the stationary engine, making it more or less similar to the automotive type, so will we modify our present automotive designs which we are now using in passenger cars to follow somewhat the racing car types.

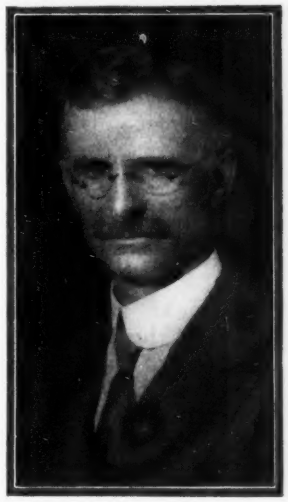
We pass milestones of development in every generation. We see the older group ridiculing the new idea and progressive thought in all things. We invariably seem eventually to accomplish the impossible and this I am sure will occur in our own industry.



¶ Impasse in Car Development May be Circumvented by FRONT WHEEL DRIVE

Will permit still further lowering of bodies and this is one reason why it may appeal to designers.

By P. M. HELDT



P. M. HELDT
Engineering Editor, Automotive Industries

FRONT wheel drive for automobiles is an old idea; many patents have been taken out on various embodiments thereof, and numerous experimental models have been built, but up to the present time the drive has found no application on stock cars in this country. If, in spite of this seeming failure, it is made the subject of an investigation in this article, it is because a sort of *impassee* has been reached in the development of passenger cars from which the front wheel drive may prove "the way out." Cars have been built lower year after year, but with the conventional bevel gear drive, at least, the propeller shaft now puts a limit to further progress in this direction; front wheel drive would remove this limitation.

The chief advantage claimed by the early protagonists of the front wheel drive was that its traction conditions are better than those of the rear drive. This holds particularly in the case of soft roads, into which the wheels sink to a considerable depth. If the front wheels are in a mud puddle, for instance, the resultant of the weight on them and of the forward push of rear driving wheels tends to force them deeper and deeper into the mud. With front wheel drive, on the other hand, the propelling force, which acts tangentially at the rims of the driving wheels, tends to lift them out of the hole.

That there is a certain advantage in the way of power required and of ability to negotiate heavy roads seems a logical conclusion—the writer does not remember having seen any test data on the point—but this was never of sufficient importance to balance the disadvantage of the greater mechanical complication of a combined driving and steering axle. It is of less importance today than ever before, because our highways are being improved at a rapid rate, and it certainly does not make any appreciable difference with respect to power consumption on concrete or asphalt roads whether the car is being driven by the front or rear wheels.

Undoubtedly the chief reason which might make the front wheel drive attractive at the present time is that it eliminates practically all restrictions with respect to lowering of the body. In a car equipped with this type of drive the rear axle would be a dead or non-rotating axle which could extend through the rear seat box, and if this did not suffice, it might even be "cranked," as it has been on certain special-purpose front drive trucks with loading platform close to the ground.

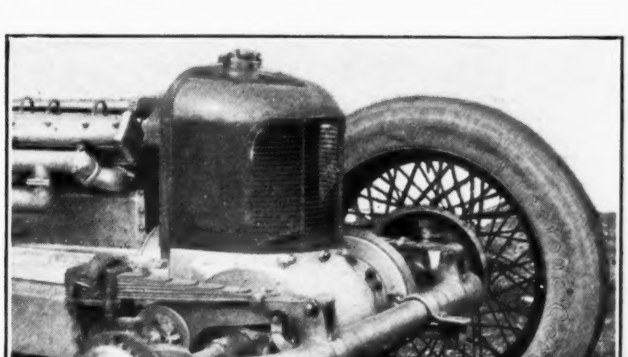


Fig. 1. Miller front drive as developed specially for racing cars

A further advantage would be that it would improve riding qualities. Riding comfort is roughly a function of the ratio of sprung to unsprung weight, and if the rear axle were rid of its differential gear and other driving members it could be made much lighter than at present. With front wheel drive the differential gear and its housing would be supported on the springs, forming a part of the powerplant, and while the rear axle would be relieved of unsprung weight,

that of the front axle would not be correspondingly increased.

A further point in favor of front wheel drive is that it permits of braking by means of the front wheels without carrying brake drums on these wheels and without the often somewhat complicated mechanism for operating front brakes. A single brake drum on the propeller shaft, either between the transmission and the drive gear or else in front of the latter, would serve to impose equal braking effects on the two front wheels. This transmission brake, acting on the front wheels, could be hooked up with the linkage of brakes acting on drums on the rear wheels to give four-wheel braking. An additional set of brakes could be fitted to the rear wheels for emergency service, if considered desirable, and the arrangement certainly permits of a considerable simplification.

The elimination of a long propeller shaft between the transmission and the rear axle also could be counted as an advantage. This shaft, if not accurately balanced, tends to whirl at certain high speeds, these critical speeds being marked by roughness in the running of the car. In the front-driven car the single long propeller shaft is replaced by two shorter transverse shafts which in most designs run at much lower speed, so that there is no occasion for whirling.

Front drive already has gained a certain measure of popularity in connection with racing cars, and whatever success it might achieve on tracks would help to smooth its way into the commercial field. In racing on circular tracks much additional resistance is encountered as a car swings into a curve, owing to the fact that the driving force, which acts in the direction of the car axis, makes large angles with the planes of rotation of the front wheels. A certain amount of sideward slip of these wheels is caused. Moreover, the unequal resistances encountered by the two front wheels, due to the fact that they are deflected through different angles, tends to cause rear wheel skidding.

With front drive the propelling force is always in the planes of the front wheels, and though it might be expected that in the latter case there would be a similar increase in the resistance encountered by the rear wheels, this does not seem to be the case. Harry Miller of Los Angeles has built several front-driven racing cars, and the Itala Co. of Turin, Italy, also built such a racer. Illustrations of these two front drives are shown in Figs. 1 and 2.

Inasmuch as higher priced cars compete with each other partly on the basis of speed, and their speeds are often established on tracks such as the Indianapolis Speedway, if the front drive has a definite advantage on such tracks it might be a desirable feature from the sales point of view. In the first important race in which a front wheel drive racing car figured, the Indianapolis 1925 event, it won second place, and this year, although the racing season has hardly started, two important events already have been won by front wheel drive machines. A higher degree of stability or freedom from skidding seems to be inherent in the front wheel drive.

The mechanical details of front drives have been worked out to a certain extent in connection with four-wheel drives for motor trucks. However, there is this difference between the two constructions, that whereas in a four-wheel-driven truck the power is transmitted to the front axle (as well as to the rear axle) through a long propeller shaft from a change-over gearbox located at about the middle of the length of the chassis frame, in a front-driven passenger car it is transmitted to the front axle directly from the powerplant, which is located in the usual position under a bonnet in front, but turned end for end, with its driving end forward.

Generally speaking, there are three methods of transmitting the power from a spring-suspended, centrally located differential gear to front driving wheels. One of them involves the transmission of the full wheel torque through shafts with universal joints at both ends, which shafts connect together short shafts keyed into the differential side gears and the hub of the drive wheels, respectively. By the other two methods only a fraction of the wheel torque is transmitted through the transverse shafts, the torque being multiplied or stepped up by gearing directly at the wheel. In the one case the drive is through spur or internal gears, while in the other it is through two pairs of bevel gears, of which one driving and one driven gear form a unit rotating around the steering pivot axis. In the case of four-wheel drive trucks, where rather heavy torques have to be transmitted, these latter two methods have enjoyed a certain degree of popularity, but it seems likely that for passenger car drives an arrangement similar to the present rear axle drives will be used, the full speed reduction required being obtained by the gearing in the differential housing at the center of the axle and each axle shaft transmitting the full wheel torque. This latter arrangement seems to be preferable for high speed vehicles because it represents a single reduction drive; a single reduction is all that is required in this type of vehicle, and is, of course, simpler and cheaper than a double reduction one. It is of particular importance in this connection that the weight saved, that of the reduction gears directly at the wheels, is unsprung weight.

A change from rear to front drive would confront the designing engineer with quite a number of new problems. It is directly apparent that front wheel drive

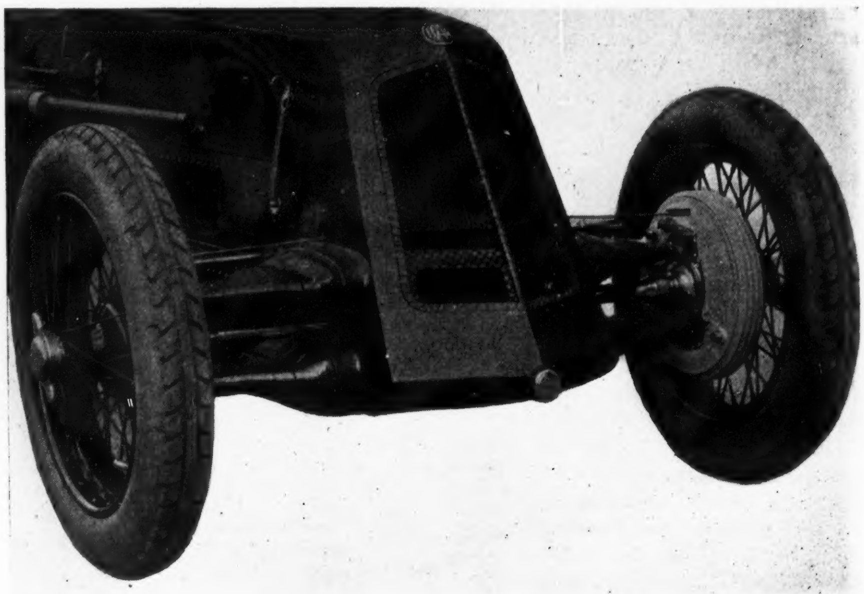


Fig. 2. Itala front drive car

would not fit in as well with modern six and eight-cylinder vertical engines as with the shorter types, such as four-cylinder and V engines. The engine would have to be placed a good deal further to the rear. In a conventional car of average size, in which the radiator is located over or slightly forward of the front axle, the distance from the center of the axle to the center of the most forward cylinder will be 8 or 9 in., which is about equal to the distance from the axis of the rear cylinder to the rear edge of the flywheel housing. In the front driven car the engine would then have to be placed farther back by a distance equal to the length of the transmission gear, measured from the forward edge of its bell housing, plus the radius of the crown gear, if a bevel gear drive is used. The over-all length of the transmission would be about 12 in. and the distance from the back of the bevel pinion to the axis of the front axle 6 in., hence the engine would have to be set some 18 in. farther back.

SINCE the writing of this article, the prediction was made in New York by Charles Faroux editor-in-chief of La Vie Automobile, of Paris, that the next important development in automobile design will be the introduction of front wheel drive models by many passenger car manufacturers.

Experiments on front wheel drives are being made secretly at the present time by many leading European manufacturers, said M. Faroux, and as a result of this activity he expects to witness the early introduction of several new front drive cars.

M. Faroux made his prediction at a luncheon tendered him by the officers of the National Automobile Chamber of Commerce, on the eve of his return to France after a six-weeks' tour of American factories.—*Editor.*

It is certainly not desirable to increase bonnet lengths over those now obtained with six and eight cylinder vertical engines, and this shows the advantage of using the shorter types of engine with the front drive. A slight shortening of the powerplant may be effected by the use of the worm drive, and this has been used in one or two designs in the past.

Problems of Design

The design of a front driving axle involves problems of considerable difficulty. Various solutions are possible, but it is not very apparent which of them offers the greatest advantages. One type of axle comprises a cranked or dropped carrying member, with a sufficient drop at the center so that it allows full spring play before the differential housing abuts against it. At the outer ends there must be swivel connections with the knuckles, and the axle end is made of the Elliott type, that is, there are two supports for the knuckle pin on the axle, instead of a single one. The reason for this is that the axle end must be formed with a hole through it concentric with the road wheel in the straight ahead position, through which the axle shaft can pass. The knuckle itself is made hollow, and a short shaft extends through it, which connects at its inner end with the axle shaft and at its outer end with the wheel hub through a jaw coupling, or it may be fastened directly into the wheel hub. If the short shaft has a bearing in the knuckle at its inner end, the axle shaft can float.

Instead of a drop axle, an arched axle may be used. This permits of hanging the powerplant lower without danger of inordinately reducing the road clearance. Such an axle, however, may make it more difficult to remove the powerplant from the chassis. Again, the cranked portion of the axle may be made horizontal and placed in front of the differential housing, as in the Miller front-drive racer, but in that case moments are created which impose additional stresses on the master leaves of the chassis springs.

Designers of front-driven cars seem to have been particularly fascinated with the plan of doing away with a supporting axle and supporting the forward end of the chassis through the chassis springs directly on the steering heads. This scheme has the advantage of cutting down the total weight, as the springs are being made to do double duty; and the further advantage of improving the riding qualities and increasing the protection of the powerplant against shock, by decreasing the proportion of unsprung weight. It is sometimes objected to this construction that the wheel tread varies with the play of the springs and that, as a consequence, there will be side slip and wear of the tires. It would seem that with the comparatively small deflection of the front springs and increased lateral flexibility of balloon tires, as compared with the high pressure type, this side-slipping of the tire treads can be entirely eliminated if the springs are made so they have no camber when under normal load. But in order to obtain a substantial connection between the steering heads and the chassis frame either three or four springs have to be used, (some of which can be replaced by rigid links.) In other words, there must be connections to the steering head at two or more points a measurable distance apart in the fore and aft direction, to steady it against shocks in that direction, and also at two or more levels, to take care of the moment due to the reaction of the ground on the wheel and the lever arm represented by the distance from the centerplane of the wheel to the points of support of the springs on the steering heads. Forces in the fore and aft direction can also be taken care of by means of radius rods from the axle end to the frame, if that is preferred to doubling of the springs.

One method of driving front wheels is through two pairs of bevel gears of which the two intermediate ones form a unit that revolves around the knuckle pin axis. The first driving pinion is mounted on the axle shaft and the final driven gear on the wheel hub. The objection to this method is, of course, that it involves transmission through two extra pairs of gears to each wheel —eight bevel gears in all—with attendant waste of power and potentialities for causing noise.

Characteristics Different

The characteristics of this drive are rather different from those of the drive in which the power is transmitted to the wheel hub directly through a shaft with universal joints. For instance, when the wheels are swung around the knuckle pins, a motion is transmitted through the bevel gears to the differential side gears. The two wheels swing in the same direction, looked at from the top, and they cause the two axle shafts to turn in the same direction, looked at from opposite sides of the car. Their motions, therefore, would be conpensated through the differential were it not for the fact that in making a turn, the inner wheel always

deflects through a larger angle than the outer one. This extra swinging motion of one wheel as compared with the other results in rotation of the crankshaft—with the power when the wheels are being deflected, and against it when they are being returned to their normal or "straight-ahead" position. Hence the steering will be non-uniform, requiring more effort to return the wheels than to deflect them from the straight-ahead position, and once the wheels are swung over to one side they will have a tendency to assume a position of maximum angularity.

It is well known that when brakes are applied, whether they act on front or rear wheels, some of the weight is transferred from the rear to the front wheels. In the opposite case, when the car is being accelerated some of the weight is transferred from the front to the rear wheels. This tends to increase the adherence of the driving wheels in the case of rear drive, and to decrease it in the case of front drive. To get an idea of what this transfer of weight amounts to, let us take the case of a car developing a maximum torque of 120 lb.-ft. having a total reduction in low gear of 15 to 1 and a wheelbase of 9 ft. Then, disregarding frictional losses, the maximum torque on the driving axle will be

$$15 \times 120 = 1800 \text{ lb.-ft.}$$

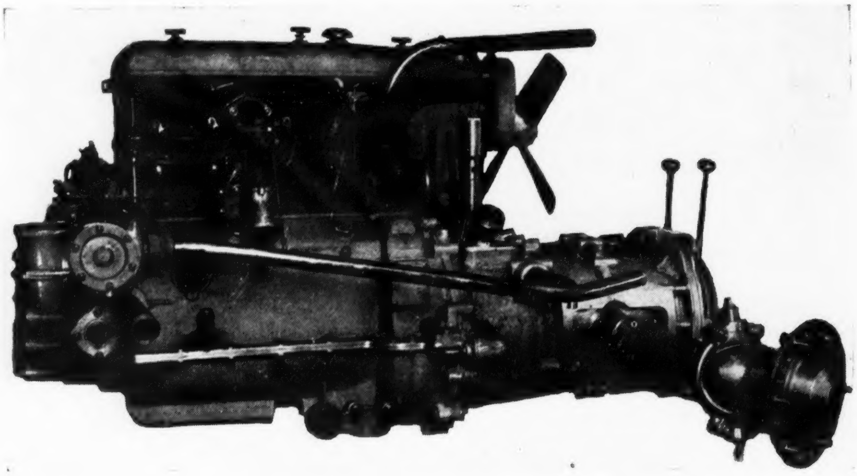


Fig. 5. Rumpler powerplant and front axle unit

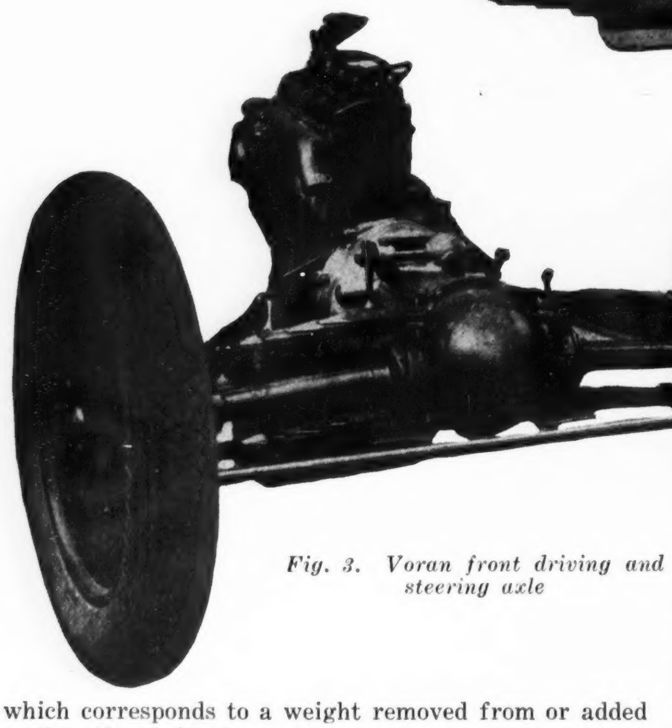


Fig. 3. Voran front driving and steering axle

which corresponds to a weight removed from or added to the other axle of

$$1800/9 = 200 \text{ lb.}$$

This would be of the order of 10 to 12 per cent of the weight on that axle. Consequently, the ground adhesion is increased by 10 to 12 per cent in the case of rear drive and decreased an equal amount in the case of front drive, and the limiting traction will be from 18 to 20 per cent less in the case of the front drive than in that of the rear drive.

With the clutch and transmission in front of the engine, the connections to the control devices would not be quite as simple as in a conventional car, and this is a disadvantage of the front drive, but not a serious one.

In the conventional rear-drive car the reactions on the axle housing of the driving and braking torque must be provided for, as well as the propulsive thrust and the drag due to the brakes. In a front-driven car, on the other hand, if the brake is supported by the powerplant and the final reduction gears are inclosed within the housings of same, all torque reactions come directly on the latter and need not be specially provided for. The case is different if there is a gear reduction at the wheels, with the driving pinions supported in bearings on the steering heads. In that case the torque reaction will come on the latter and they must be properly supported against it.

Driving thrust and braking drag originate at the ground contact surfaces of the tires and must be taken up either through the springs or through radius rods.

A word in regard to universal joints for front drives will not be amiss. Of the two universals in each drive shaft, the one near the central housing has to take care only of the angularity due to spring play. Fortunately the vertical play of the front spring is not very great, being limited to about 2 in. to both sides of the normal position. Moreover, spring play does not affect the parallelism between the differential shafts and the knuckle shafts, and the angle between the differential shaft and the axle shaft is always the same as the angle between the axle shaft and the knuckle shaft, hence the speed fluctuations created by one joint will be neutralized by the other.

It is different, however, with respect to the angularity between shafts due to steering motion. The angle of the steering spindle with the axle may exceed 30 deg., in fact it may reach 40 deg., and for such angles there would be extreme fluctuations in the speed of the driven member if the speed of the driving member were constant. For an angle of 30 deg., for instance, the speed of the driven shaft would fluctuate through a range equal to 29 per cent of its mean speed. Actually, of course, neither the driving nor the driven shaft would run at constant speed, but one would accelerate and the other at the same time decelerate, and both would be subjected to very great stresses as a result of these

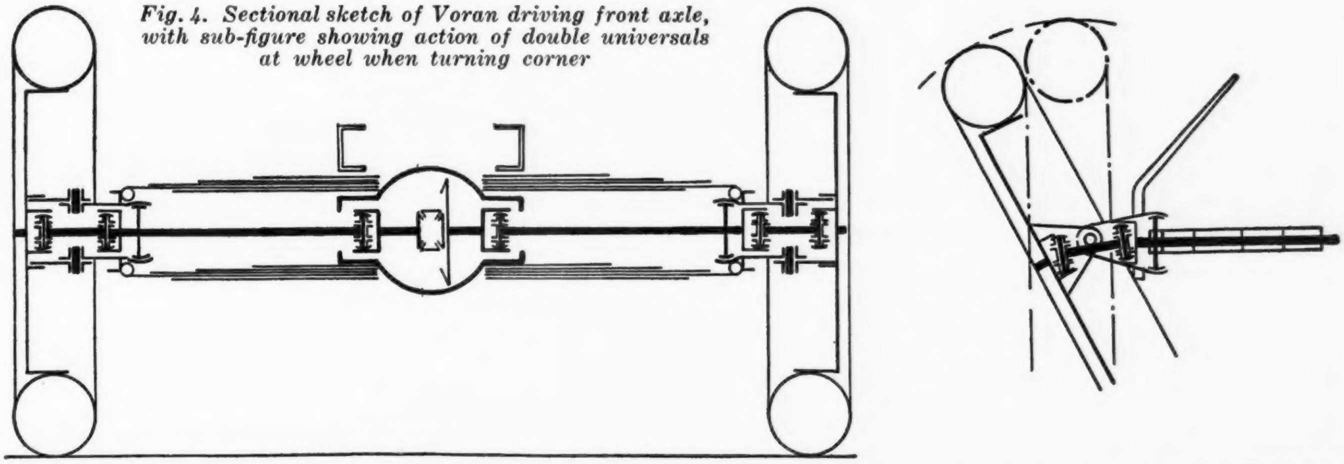


Fig. 4. Sectional sketch of Voran driving front axle, with sub-figure showing action of double universals at wheel when turning corner

accelerations and decelerations, because of the heavy masses connected with them.

It would therefore be desirable to use at the knuckle end of the axle shaft either a type of universal joint that is free from these periodic fluctuations, or else two joints located close together and symmetrically on opposite sides of the knuckle pin axis when the wheel is in the straight ahead position. Then, if the wheel is swung around for steering, each of the two adjacent universals will assume the same angularity and the fluctuations in the transmission ratio due to the two joints will cancel out.

In the following will be given brief descriptions of front wheel drives found on cars exhibited at last year's Berlin and Paris shows.

Voran Front Drive Car

The Voran front drive car, made by the Voran Automobil--Bau Aktien Gesellschaft of Berlin, is a light car with a four-cylinder 2¾ by 3¾ in. engine developing a maximum of 25 hp. It has a tread of about 50 in. and a wheelbase of about 106 in. The weight of the four-passenger sedan is 1760 lb. Engine, clutch (multiple-disk-in-oil type), three speed transmission and final drive are combined in a block. In fact, this unit with the two front wheels and the springs form a unit which can be readily rolled out from under the car and replaced by another, similar unit, which makes the construction particularly suited for commercial vehicles for operation in fleets.

The spiral bevel final drive gears (5.28 ratio) and differential are inclosed in a spherical housing, to each side of which are secured two quarter-elliptic springs which support the steering heads. These steering heads are braced against fore-and-aft forces by radius rods extending to points on the housing of the powerplant, apparently to the supporting arms on the flywheel housing.

At the wheels double universal joints are used, the centers of which are equally distant from the steering knuckle pin axis on opposite sides. The outer end of the axle shaft is supported in a spherically seated bearing, while the short shaft connecting the two universals at the wheel floats.

In this car the service brake acts on the front wheels only, and it is claimed that, since both braking and driving are effected through the front wheels, the machine holds the road unusually well and is free from any tendency to skid. The hand emergency brake acts on the rear wheels. Fig. 3 shows the Voran front axle

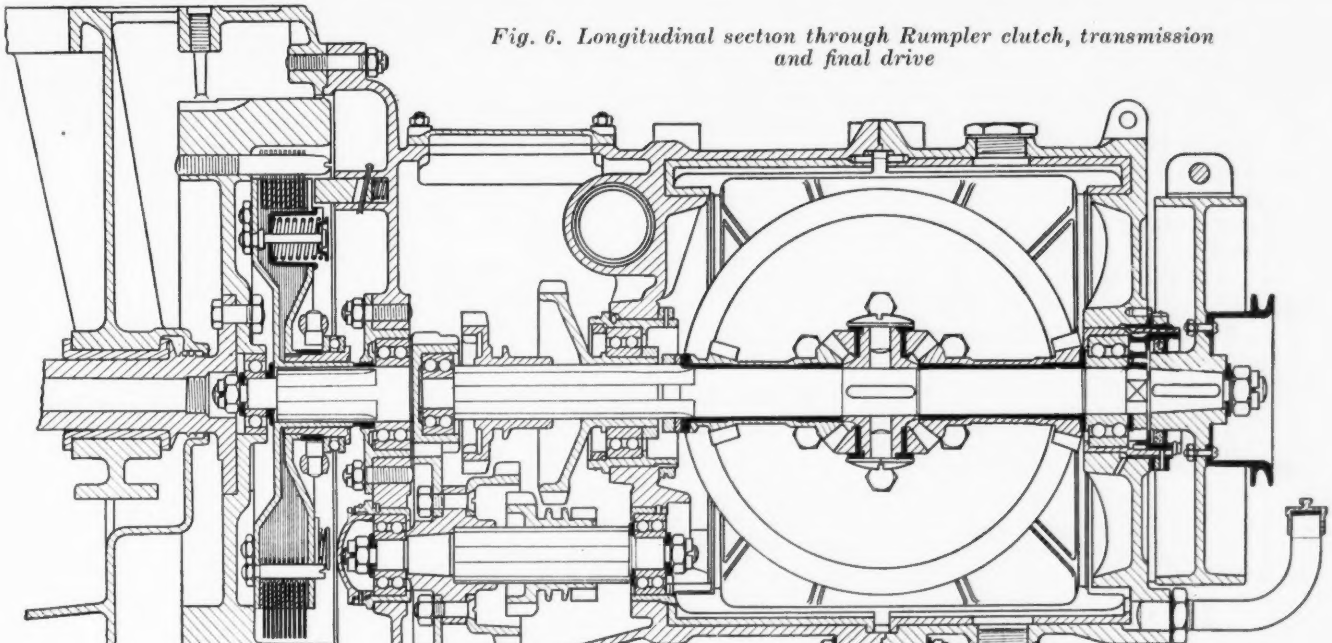


Fig. 6. Longitudinal section through Rumpler clutch, transmission and final drive

while Fig. 4 is a sectional sketch showing the angular relations of the shafts in the straight ahead position and in turning corners.

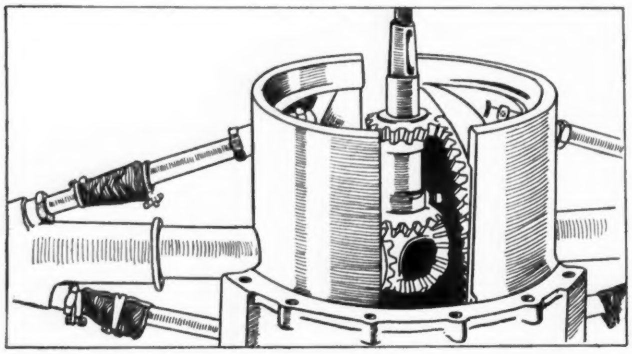


Fig. 7. Sketch showing assembly of axle tubes with central housing in such a manner as to allow each tube to swing independently

Dr. Edwin Rumpler, of Berlin, also builds a car with front wheel drive. He employs a four-cylinder engine of 3.15 in. bore and 5.12 in. stroke developing 50-55 hp. Engine, transmission and final drive are combined in a single block which is supported on the frame by two tubular members passing through drilled bosses cast on the crankcase and gearcase respectively.

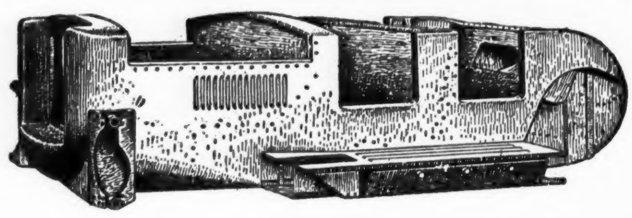


Fig. 8. Sketch of light alloy automobile body designed by Dr. Kamm. In this car a chassis frame and axles are dispensed with and the wheels are mounted on brackets riveted to the four corners of the body

The Rumpler axle construction is quite unusual in that the axle ends to which the knuckles are pivoted are carried by tubular members surrounding the drive shafts; these tubular members are not fastened rigidly into the central housing but have independent pivotal motion around the fore and aft longitudinal axis, or the axis of the propeller shaft. This is made possible by mounting the differential gear on the propeller shaft instead of on the driven shafts, and it is really around the axis of the differential gear that the two axle halves swivel. Each axle shaft has its own crown gear which is driven by a separate bevel pinion on one of the differential side gears. In order to prevent interference between the two sets of bevel drive gears, they are made different in size. The two axle tubes are fitted into sectors located on the inside of the cylindrical housing over the differential. These sectors are comparatively wide and in addition to the axle tubes, two brace rods are anchored in each, which give the axle the necessary horizontal stiffness.

The axle tube ends in a spherical housing which incloses a universal joint connecting to the knuckle shaft. This universal joint evidently is working only when the steering wheels are deflected from the straight ahead position.

At the front the frame is supported on the axle ends by means of two pairs of transverse semi-elliptic springs. The propeller shaft extends entirely through the drive gear housing and carries a large brake drum at its forward end, to which a pair of contracting brake shoes can be applied. In the Rumpler construction, too, the powerplant and front axle form a unit which can be readily replaced by another.

A very unusual car embodying front wheel drive has been designed by Dr. Kamm who is in charge of the engine department of the Adlershof Flying Field. It was to have been built by the Schwabische Huttenwerke, which concern, however, is reported to have sold its machine works recently.

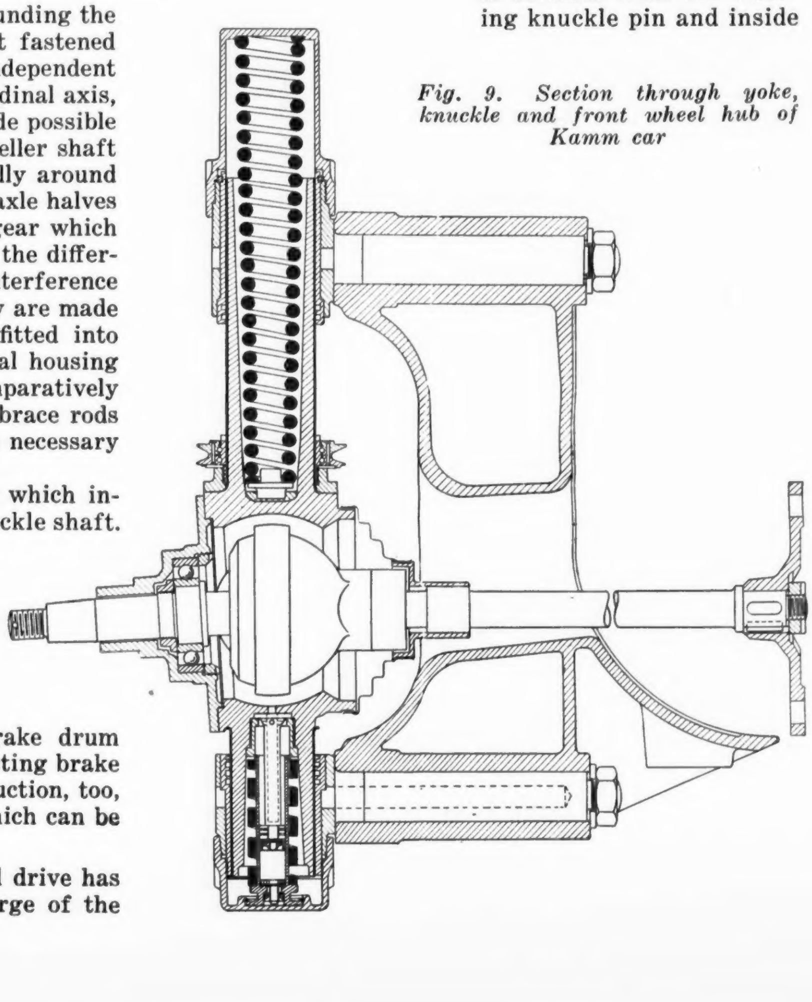
Dr. Kamm's chief aims seem to have been to lighten the whole construction and to build very low—for safety at high speed. He uses an all-metal body which forms the sole supporting structure. It is made entirely of light alloys (aluminum and magnesium) of sections which can be readily blanked and formed to shape. The shell is stiffened by strongly riveted bulkheads and by box-shaped running boards or steps below the door openings, which serve as tool boxes. Body and powerplant are separate units and can therefore be separately assembled. The complete body weighs only 300 lb.

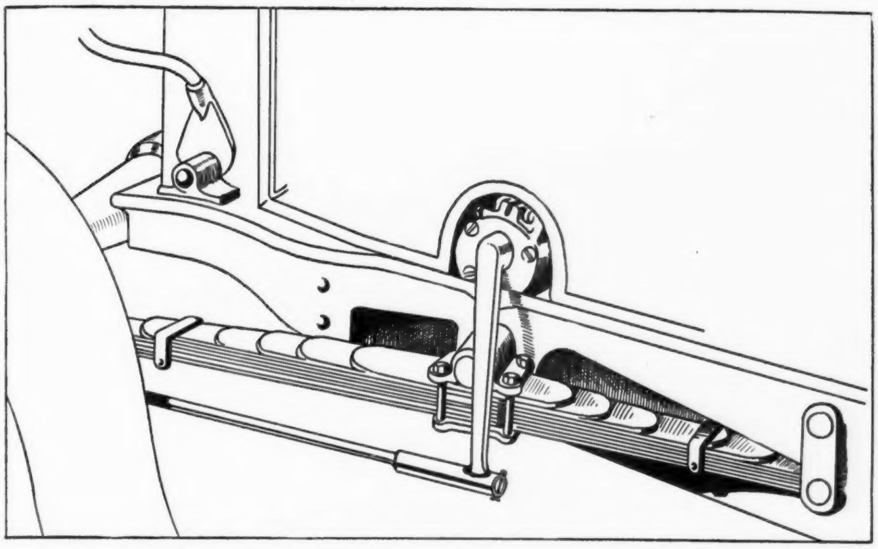
Cast Bracket at Each Corner

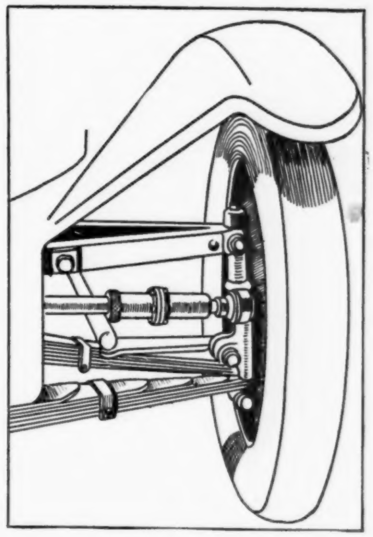
At each corner of the body there is a cast bracket, which carries a spring-mounted spindle for one of the road wheels. A sectional view of one of the front brackets with its spring-mounted knuckle is shown in Fig. 9. Into the bracket are secured two horizontal eye bolts, the eyes of which are passed over integral trunnions on the knuckle through a long coiled spring in the upper knuckle trunnions while another short and stiff coiled spring in the lower trunnion serves to limit the recoil.

Two universal joints are used in each axle shaft, which latter extends through an opening in the side of the body and in the bracket. The one at the inner end is a fabric joint, while the other, which is co-axial with the steering knuckle pin and inside

Fig. 9. Section through yoke, knuckle and front wheel hub of Kamm car







Left, Fig. 10—Spring suspension and front-driven axle of Bucciali car. Right, Fig. 11—Front driving axle construction of Ed. Parville electric car

the spherical housing of the knuckle, is of the metallic type. The short drive shaft inside the knuckle spindle is supported in a ball bearing mounted in the spindle and is designed to be keyed into the wheel hub which latter is supported by a ball bearing mounted on the outside of the spindle. The drive is transmitted in a very effective way through the trunnions of the knuckles.

Several front-drive cars were shown at the last Paris automobile show. In the Bucciali car the arrangement of the engine, clutch, transmission and final drive in a single unit is substantially the same as in the systems already described. A praiseworthy attempt has been made to make the appearance of the front conform to that of standard rear-driven cars. To this end the radiator is formed with a central circular notch at the bottom into which the driving gear housing fits. This gives a front elevation very similar to that of certain other French cars in which the combined generator and starter is mounted at the front of the engine and under the radiator.

In this car the front axle tubes are made of trumpet form, and they pivot around the axis of the propeller shaft or bevel gear shaft. Half-elliptic cantilever springs are used at the front. These are arranged at an angle to the longitudinal axis of the frame and extend through slots in the webs of the frame channels, the center mounting of the spring being just outside and the rear eye inside the channel. At their forward end these springs are jointed to the axle tubes. Truss rods extend from the bottom of the driving gear housing to the lower part of the axle end, to insure parallel motion of the axle ends under spring action. Universal joints are inclosed in the steering knuckles in the usual way.

In another French front drive, the Ed. Parville electric vehicle, the steering head is supported by two quarter-elliptic springs with their butts fastened to the driving gear housing. These two springs, which are on a common level, do not run parallel but approach each other toward their smaller ends, which latter are pivoted to the lower end of the steering head. The upper end of the head is similarly connected to the driving gear housing by a triangular linkage, the links being somewhat shorter than the springs. Springs and links in different vertical planes maintain the steering heads in substantially vertical positions while the triangular or diverging arrangement of each gives the necessary strength in the horizontal plane.

The special articles presented in this issue of *Automotive Industries* represent the views of the contributors on subjects which were assigned to them in advance by the editor. The contributors in all cases are automotive engineers of high standing and consequently their views will command attention.

Nevertheless, some of the subjects covered, as is apt to be true of so many engineering subjects, are of a controversial nature, and all who read the articles may not agree with the conclusions that are drawn.

From such as may hold different opinions on any or all of the subjects treated, we invite comment. This invitation is extended in the belief that the expression of conflicting opinion, where justified, will prove not only of general interest but of value in helping to clarify the important engineering problems which are discussed.—*The Editor.*

J. H. Hunt

J. H. HUNT, What

Important to keep in touch with all branches of human activity and wide variety of books, papers and periodicals should therefore be included in the regular literary diet.

By J. H. Hunt

ENGINEERS surely need to keep in touch with all branches of human activity. If we become completely submerged in the mass of detail involved in the engineer's daily work, we may fail to get any satisfaction from the knowledge that our own work, however much it may lack spectacular features, is part of a total of great importance to humanity in general.

Further, the engineer should feel a certain sense of responsibility for the results of the activities of his profession. Without making any contentious statements about the relative importance of the various professions, one can safely say that if the results of the last two hundred years of the engineers' work were lost, we would slip back to a civilization very little in advance of that of the Romans, and a large percentage of our present population could not exist due to lack of means of subsistence. The engineer is concerned with what use society is making of the results of his work.

"Fairy-Story" Advertising

Reading for amusement will not be discussed. Tastes in detective stories vary too much. There is no need for a list of fairy stories while our national weeklies carry the present type of automobile advertising. Courses in reading for "culture" have been prescribed by too many experts for any engineer to risk competing in such a field. Finally no one engineer has had time to support himself in a highly competitive profession, and do sufficient reading even in lines that might be of useful interest to him so that he would be in a position to make out a list covering what might be called a useful, educational course in reading. If such a list is ever built up, it will have to be done by specialists in each subject covered, working in consultation with engineers. I would like to make a plea for such a list. It is rather disheartening to take the time to read a book on some subject sufficiently off one's own line of work to make the going just a little hard, and then find that most of the experts in the field covered believe that the fundamental data have been carelessly taken, and quite unjustified deductions made from this data.

No list of titles will be made up by the writer for the reasons given. An attempt will be made to list subjects on which the engineer should have a certain amount of information, part of which must be obtained from reading. Reading can supply only a part, principally for a reason mentioned above. It is impossible to have any critical ability to evaluate work done in an unfamiliar field. Furthermore books written by one not handicapped by too great a sense of necessity for accuracy are likely to seem more interesting to the uninitiated than the carefully written review that gives a really accurate picture. One should have friends and acquaintances active in various fields, with whom one can discuss such questions and maintain a perspective. The engineer is unfortunately handicapped in this regard. Too often he is compelled to shift his location so frequently that he finds it impossible to maintain continuously the proper type of contacts. The people with whom he works are not likely to have very broad interests, or if the interests are there, there is a tendency to conceal them, and limit conversation to a rather superficial discussion of politics, business or professional sport.

The engineer should read some history, not the history of dynasties or parties, but the history of civiliza-

PRESIDENT OF S. A. E., DISCUSSES

Engineers Should Read

tion, the history of the development of the arts, and the beginning of science. There is not enough of this kind of history available today, but the appearance of the "Outline" type of history show that the need is being recognized.

It is rather significant that the most popular of these works have not been written by professional historians, and that the professional historians have been in general highly critical. It is to be hoped that people with the proper historical sense will undertake to trace the development of the application of the various manufacturing tools and processes, and study the effect of these upon the welfare of peoples in general, finally presenting the results of their work in a form that leads one to follow through to the finish.

We have exceedingly well written historical novels, built around the personality of soldiers and politicians. Are the lives of the pioneers in industry any less interesting?

The above may seem to indicate that the engineer should read something not yet written. Many things he should read are not yet written, but if he is looking for them he will find something occasionally that is well worth his time.

Good biographies frequently present history in a much more attractive form, and fortunately there are now available well written lives of men whose careers are very instructive to engineers.

The writer personally feels that the autobiography of Dr. Pupin represents a contribution to our present and future generations that compares very favorably with the scientific activity of that gifted inventor. This autobiography gives a view of the history of our own times that no formal history can succeed in picturing as effectively.

All of an engineer's work is intended for the use of his contemporaries and their immediate descendents. These people can have only that for which they can afford to pay. The engineer is vitally interested in economics. Just how far he is justified in going along such lines depends on how far his own responsibilities go or are likely to go. In any event he should read a standard text book or two on economic theory to get the vocabulary and to get a picture of the background of the average writer on economics.

It will assist a great deal in reading a text book or an article on economics to remember that there has never been any controlled experimentation in economics in the sense that there has been in engineering. Deductions have been based on studies of complicated interrelations of economic forces. These forces have been weighed according to the judgment of each writer. This helps one to understand why there is just as much variation in opinion among economists as to the effects of the development of the automotive industry upon American prosperity as there is variation of opinion among automotive engineers as to the proper way to control the valve operation of an engine.

AFTER developing a small amount of perspective one can find much of interest in the articles on economics in our more serious reviews. Even if one brings a rather skeptical attitude to this reading, he has the comfort of knowing that he can disagree with almost any author and have the support of many people who admit they are economic experts.

Books and articles on social organization are of vital interest to the engineer, if he but remembers that most of proposed schemes for the increase of human happiness by social reorganization are based on the theory that the sum total of the engineers' work, applied science in general, and the work of our present business organizations can some way be more effectively utilized than at present.

Where anything like free discussion is allowed, and where the general public has control of public policy, changes in social organization come slowly enough so that the engineer can adapt himself to them. It is a real advantage, however, to have some fairly definite idea as to tendencies. The viewpoint of the public 30 years from now is being determined to a certain extent by the literature on sociology that is now being supplied

from the various sources. Tendencies toward governmental control or operation, and tendencies in the organization of this government control will decide whether one's younger relatives with creative ability should risk careers in many branches of engineering.

If one has faith in the necessity of one's own work, he is justified in examining proposed plans of social reorganization, and trying to see just how the engineer would function and what he could hope to accomplish. This is not necessarily a purely selfish viewpoint, and if every group were doing the same thing, there would be an important stabilizing force against change for the sake of change alone. When an engineer has to replace a bridge, he may move the old one first, but it is only rarely that the old one is destroyed without providing an equivalent during construction.

RADICALS are likely to think of engineers as being unduly conservative, doubtless because engineers are likely to take the same attitude toward social organizations as toward engineering structures. There is considerable mental stimulus however in publications carrying radical propaganda. It helps one to understand the difficulties of government.

Economics, sociology and politics are so tied together in their effects on men's minds that current articles touch all three simultaneously. Our interest in them is not limited to the United States, but covers the entire world.

The writer finds much information along this line from a magazine republishing articles translated where necessary) which have appeared in foreign periodicals. Such information is of course opinion regarding facts rather than the facts themselves. In this field, however, what the world thinks the facts may be is more important than the facts themselves.

Engineering work in the future, particularly engineering connected with manufacturing, will be very greatly affected by the world's opinion on questions of economics and social organization. We have a very real interest in this opinion.

Biology is an important subject, some phases of which are of immediate interest to engineers who have to carry out operations away from the ordinary conveniences of American cities. To mention only one case, the Panama Canal would probably never have been constructed if the combination of medical and biological science had not made the control of yellow fever possible.

Modern methods of sanitation and provision against some forms of disease are almost as much engineering as biology and medicine. This relation is so clear that courses in public health are included among the curricula of some of our prominent engineering schools. A knowledge of modern theories of the functions of vitamines is essential to the success of any project where the food must be supplied by the management. This knowledge is particularly essential on locations where canned food must be the basis of the dietary.

The engineer, just as any other educated man, should read enough general biology to be able to vote intelligently in these days of referendum and agitation for the limitation of the freedom of teaching in biology.

The philosophers claim to cover all knowledge, surely an ambitious program when most men of good intelligence and industry cannot cover the field of their own specialty. Most engineers would find Will Durant's "Story of Philosophy" most interesting.

It has always seemed to the writer that most books on such subjects are written fully as much to demonstrate the author's erudition as to clarify an already confused situation. Durant does not claim to understand philosophy, and has no intention of trying to do so, but his book seems thoroughly worth while, as it shows what the philosophers are trying to do. We must have a little knowledge of this, for while the viewpoint of the average philosopher does not affect either the work or the viewpoint of the average engineer, still educated men in other lines are likely to hold the philosopher's opinions in great respect, and we need the understanding and cooperation of educated men in other activities.

Given sufficient previous historical reading so that the books seem somewhat intelligible, there are many stimulating ideas for engineers in such a heavy book as Spengler's "Decline of the West." Ideas are sufficiently hard to get to justify some real effort. The writer hardly claims that many of these ideas have a commercial value, but an engineer in educational work

SOMEONE might possibly ask the question, how can I start after having done no general reading for years? As far as science is concerned, the symposium put out by the University of Chicago entitled the 'Nature of the World and of Man' will give an excellent introduction, after which articles in Science or the Scientific Monthly will not seem quite so difficult.

"If one wishes to get a little better knowledge of modern theories regarding the structure of matter, Mills' 'Within the Atom' will provide a fine introduction.

"Einstein's small non-mathematical book on 'Relativity' has nothing within the covers beyond the capacity of any engineer. A reading will provide an antidote to some of the careless statements often heard on the subject. Equally satisfactory books on other subjects can be located with a little trouble.

"In general, reading is a good deal like swimming. The main thing is to get into the water. After getting into the habit one finds reading a pleasure rather than an effort, even if the subject matter seems formidable enough so that it sounds a little like bragging to mention it."

would be likely to find them really useful.

Reading along the lines of one's own particular work is a personal problem, since it should be directed toward filling the blank spots in one's mental map of the particular activity. Books in one's specialty that are sufficiently up-to-date are likely to be rather rare, if one is really a student of his own job. Books on related lines of activity are more likely to be useful. This limits most reading on the specialty to technical articles. One is in the position of preparing to write a book on the subject which can never be completely mastered, as new questions arise faster than the old ones can be answered.

Some Reading Matter Which Mr. Hunt Suggests

The autobiography of Dr. Pupin.
Will Durant's "Story of Philosophy."
Spengler's "Decline of the West."
Publications of the Bureau of Standards.
"Nature of the World and of Man."
Mills' "Within the Atom."
Papers of the different engineering societies.
Technical magazines and abstracts.
Einstein's "Relativity."

One should naturally read the journal of the technical society of one's specialty; including the journal of the British society in the same field, this being supported by one or two of the better technical journals. For the automotive engineer, this would cover the *Journal of the Society of Automotive Engineers*, the papers presented to the Institute of Automotive Engineers, *Automotive Industries* and the *Automobile Engineer.* This should be supported by part of the papers before the A.S.M.E., the A.S.T.M. and, for some phases of automotive activity, by part of the papers before the A.I.E.E. and the I.E.S.

This list is of course too long for anyone to cover completely. *Automotive Abstracts*, supported by *Mechanical Engineering Abstracts*, can be run over to select the titles that need real attention.

Occasionally a young man will take reading too seriously, spending too much time in this way. The demands of the job and the family will protect the older men. In any event the reading should not be carried to the point of dulling one's critical faculties. More can be obtained by reading an article which is finally decided to be wrong from start to finish if one takes the trouble to analyze the subject in so doing, than by reading an article that proceeds so smoothly from preliminary analysis to final deduction that one is led to imagine a better understanding of the subject than is really possessed.

The engineer in research work will need to keep in touch with new developments in physics and chemistry and with literature covering the development of new materials that may be available. Any publications put out by research organizations in other lines of engineering work will amply repay the time that can be spent. One does not need to be an electrical engineer to get much of value from the publications of the Research Staff of the General Electric Co. appearing in the *G. E. Review*, and many papers put out by the staff of the Bell Telephone Laboratories will prove of interest in widely different fields.

The publications of the Bureau of Standards deserve much more attention than they are now given by engineers in general. *Science Abstracts*, covering physics and electrical engineering, and *Chemical Abstracts* will enable one to keep in touch with what is going on without wading through too bulky a mass of material.

The engineer in any line should have a general knowledge of physics and chemistry, at least to the extent of knowing in a general way what the underlying theories are, what are considered to be the important unsolved questions, and what methods of attack are being used. One thing that can be gained from this is some sense of the fundamental unity of science. The chemist and physicist that are working in fundamental rather than detailed problems are really trying only slightly different methods to obtain the answer to the same questions, many of the important problems of the biologist are beginning to appear as chemical problems, and any improvement in instrumentation in one science always has immediate reactions in another. Vacuum tube amplifiers are in use in biological laboratories, and facts developed in experimental psychology are applied to increase the accuracy of astronomical measurements.

This article is obviously based only on the writer's own limited reading, and makes no claims whatever to being balanced. Thus the important subject of psychology, which surely cannot be ignored, is passed over without any recommendations. Books on psychology for the general public seem to be so conflicting that a nonprofessional opinion is of very doubtful value. After reading all or part of a good many books which have been dismissed from mind as having been written by people that are really not scientists, the writer finds himself too confused to attempt discussion. He also counts any time spent by himself in reading a little geology as time spent for his own pleasure, rather than used for indirect benefit. In the case of a mining or a civil engineer, geology becomes a professional subject.

Non-Readers Sometimes Leaders

Some engineers already cover a much wider range of reading than mentioned above, many read almost nothing. Some of the latter are leaders in their profession because they are discovering the very information about which other people will sometime write. The writer does not expect that any engineer will change his habits in reading because of anything written here.

Someone might possibly ask the question, how can I start after having done no general reading for years? As far as science is concerned, the symposium put out by the University of Chicago entitled the "Nature of the World and of Man" will give an excellent introduction, after which articles in *Science* or the *Scientific Monthly* will not seem quite so difficult.

If one wishes to get a little better knowledge of modern theories regarding the structure of matter, Mills' "Within the Atom" will provide a fine introduction. Einstein's small non-mathematical book on "Relativity' has nothing within the covers beyond the capacity of any engineer. A reading will provide an antidote to some of the careless statements often heard on the subject. Equally satisfactory books on other subjects can be located with a little trouble.

In general, reading is a good deal like swimming, the main thing is to get into the water. After getting into the habit one finds reading a pleasure rather than an effort, even if the subject matter seems formidable enough so that it sounds a little like bragging to mention any acquaintance with the subject at all.

Effect of Increase in Engine Production

Improvement in performance and economy calls for reduction in weight and first step is increased speed

FEW subjects relating to automobile engine design are more controversial than that of engine speed. It is the constant jeer of the steam car enthusiast that the automobile engineer designs engines which are more liable to be hammered to pieces by the fact that they are rotating light than by the fluid pressures which constitute their motive force. Yet, each succeeding year shows lower rear axle gear ratios in practically all classes of cars with a higher engine speed for the same road speed than hitherto. The deep-seated desire for improvement in performance and economy in all prime movers calls primarily for reduction in weight, the first step towards this end being an increase in speed.

The development in the United States of the so-called European type of car during the past two years revives the question of the relative merits of high speed and low speed engines which was a matter of keen discussion some 20 years ago when the "roaring forties" were being threatened by the then modern three-litre or 180 cu. in. engine. This time, however, it is the 180 to 240 cu. in. engine which is having to fight the claims in respect of power, economy, and light weight made by the 120 cu. in. engine and its like.

The increase of engine speed has been the outstanding point of technical interest in modern racing engine design in which a decrease of engine size has been accompanied by an increase of car speed.

How Useful Are High Speeds?

The issue now arises as to whether these high engine speeds can be usefully employed in the automobile of everyday use.

It may be worth while mentioning that the horsepower developed by an engine depends upon the average pressure exerted on the pistons and the distance the pistons move per minute under the influence of this mean pressure.

The mean pressure on the pistons in pounds multiplied by the radius of the crank in inches, divided by 1.57 is the torque of the engine in pound-inches. Horsepower, therefore, is proportional to torque multiplied by revolutions per minute. Thus a torque of 2000 pound-inches will produce 47.6 hp. at 1500 r.p.m., or 1500 pound-inches torque will produce 47.6 hp. at 2000 r.p.m., or 1000 pound-inches will produce 47.6 hp. at 3000 r.p.m.

If for a moment it be granted that engines peaking at say 6000 r.p.m. are just as reliable, economical, and as cheap to make as existing types, it is obvious that the reduced sizes of clutch and transmission allowable through the reduced torque constitute very important potentialities in respect of reduced cost of production.

Laurence H. Pomeroy

Regarded from the historical viewpoint, there has been a steady increase of engine speed during the past 20 years in which the United States has, contrary to general opinion, led the way.

The United States developed the "all on high" type of car, necessitating a low rear axle gear ratio and therefore for the same road speed (which is not so different in the United States and Europe), an engine which gave about 50 per cent more revolutions per mile always and per minute at its maximum speed. European practice has in general, followed the United States in this respect but not nearly to the same extent, since the "all on high" type of car pays heavily for this advantage in high petrol consumption

Speed *on* Weight *and* Costs

By LAURENCE H. POMEROY

Cheaper to produce high-speed engine because it is smaller; savings reflected throughout car

"POMEROYISMS"

¶ Regarded from the historical viewpoint, there has been a steady increase of engine speed during the past 20 years in which the United States has, contrary to general opinion, led the way.

* * *

¶ The high engine speeds of which the modern European engine is capable are used via the transmission and in this respect the average English car easily puts to shame its American competitor.

* * *

¶ The extent to which the small high-speed engine produces a lighter chassis than the larger low-speed engine is one of its chief claims to the attention of the designer. It is impossible to dodge the implication of total weight.

* * *

¶ The economical manufacture of existing American cars has been largely the result of the activities of the machine production expert who in many cases has taken liberties with the canons of design.

* * *

¶ The development of the really high-speed car engine offers a new opportunity to the skilled designer, as the reduction of 20 per cent in the weight of the engine by a reduction of 33 per cent in the cylinder unit capacity brings about at one fell swoop a saving which is far more than the production expert has ever achieved by playing havoc with the laws of stress distribution in the interests of intensive manufacture.

* * *

¶ The first step toward the realization of the advantages of the high-speed engine is to make existing engines perform continuously at the speeds of which they are now capable for short periods. The next is the scaling down of the cylinder unit size and incorporation in the new design of the experience thus gained.

* * *

¶ There seems an increasing disposition on the part of the buying public to accept the high-speed engine and in this disposition, which may easily be turned into a positive demand, lies a distinct opportunity for the automobile engineer to show the world some real engineering.

and until quite recently petrol has been rather a luxury in Europe, to be used as sparingly as possible.

The high engine speeds of which the modern European engine is capable are used via the transmission and in this respect the average English car easily puts to shame its American competitor.

The driver has been driven recently in American cars of repute by a driver accustomed to the gear shifting necessitated by a small French car. These experiences have shown him pretty clearly that as a means of improving average speed, gear shifting on American cars is of little or no use, while the petrol consumption obtained by such driving was unbelievably bad.

All automobile engines are characterized by the fact that the normal load factor or proportion of available horsepower actually used at constant speed is very small, as is also the total time during the life of a vehicle when it is driven at its maximum speed. There is, however, an insistent demand for rapid acceleration, i. e., the development of maximum torque over what is usually only a portion of the speed range.

It is this low load factor in an automobile engine which dominates the situation in respect of design and is responsible for the empirical nature of so many constructional details. "It works" is the triumphant answer of the sponsors of some mechanical abortion, used where an orthodox construction would work still better were it fully realized that at 30 m.p.h., about 6 hp. is required from a power unit capable of producing 60 hp.

Apart from the question of high speed or low speed engines, fuel economy is primarily a factor of the nature of the high gear performance required and it is only possible to obtain good economy and high gear performance by a reduction in overall weight. The extent to which the small high-speed engine produces a lighter chassis than the larger low speed engine is one of its chief claims to the attention of the designer. It is impossible to dodge the implication of total weight.

Difference One of Bearings

The essential difference between the high-speed and low-speed engine, each developing the same maximum horsepower is that the dimensions of the bearings on the high-speed engine are determined by the maximum inertia forces, while in the low-speed engine they are determined by the pressures set up, due to the explosion stroke.

For this reason the automobile engine of commerce, while capable of speeds of 3000 r.p.m. and over for short bursts, will not in general maintain these speeds reliably for long periods. The necessities of the development of the automobile engine are only now beginning to call for genuine high speed reliability. On the other hand, airplane engines with cylinder units of 5⅛ in. bore by 6¼ in stroke, i. e., 120 cu in. per cylinder, are capable of continuous full power running at 2800 r.p.m.

Such engines have the same capacity per cylinder as the popular 2-litre or 120 cu. in. engine which in its racing form may have eight cylinders of 15 cu. in. each.

The development of the high speed airplane engine has involved much study of detail but practically nothing in the shape of any departures from estab-

lished general design. Thus such engines are not inherently more expensive to build than the lower speed types but much study has been necessary to arrive at the correct shape of valve heads, design and material of valve seats, combustion chamber shape, rigidity of bearings, etc., to attain the desired end.

The economical manufacture of existing American cars has been largely the result of the activities of the machine production expert who in many cases has taken liberties with the canons of design.

The development of the really high speed car engine offers a new opportunity to the skilled designer as a reduction of 20 per cent in the weight of an engine by a reduction of 33 per cent in the cylinder unit capacity brings about at one fell swoop a saving which is far more than the production expert has ever achieved by playing havoc with the laws of stress distribution in the interests of intensive manufacture.

MR. POMEROY is an English engineer who is placed in the happy position of being able to address American engineers with a clear understanding of their everyday thoughts and problems, having spent six years in this country. He is a member of the S.A.E. and has a wide acquaintance among its members.

Mr. Pomeroy came to this country in 1919 and took up experimental work with the Aluminum Co. of America, later specializing in the development of aluminum parts and bodies for the American Body Co. He is now chief engineer of the Associated Daimler Co. Ltd.

He is a member of the Institution of Mechanical Engineers, the Institution of Automobile Engineers and a Fellow of the Royal Society of Arts, in addition to retaining his S.A.E. membership.

Increasing engine speed is one of the most interesting problems before the engine designer today. It is essentially a practical development by no means to be solved on the grounds of theoretical reasoning only. In saying this, particular reference is made to the development of engines of the six-cylinder type foreshadowed, or rather definitely introduced, by the Packard company when the Packard Light Six was brought out some years ago, from which so many copies have been made.

Raising Peak Revolution

Such engines, varying from 220 cu. in. to 280 cu. in. developing from 60 to 70 hp. are, in the writer's opinion, capable of development as a first step to the extent of raising the peak revolution from about 2500 r.p.m. to 3500 r.p.m. and the peak horsepower to 80 or 90.

This horsepower is, however, not generally required by the motoring public, which at all events for some years to come, can get all it requires from an engine developing about 60 hp.

The problem then becomes that of redesigning the present six cylinder engine of approximately 240 cu. in., giving 60 hp. at 2500 r.p.m. to 2700 r.p.m. to give 60 hp. at say 3500 r.p.m. to 3700 r.p.m.

The orthodox L-head type of engine referred to above, with American hot spotting, will develop an indicated mean effective pressure of about 110 lb. per sq. in.

There is no difficulty in maintaining this indicated m.e.p. up to speeds of 3500 r.p.m. and with suitable valve and inlet pipe design the mechanical friction (as apart from pumping losses) will not be much more than 5 lb. per sq. in. higher at 3500 r.p.m. than at 2500 r.p.m.

Thus if the present engine develops say 80 lb. per sq. in. b.m.e.p. at 2500 r.p.m., the engine designed to give the same horsepower as before but at 3500 r.p.m. should develop about 75 lb. per sq. in. b.m.e.p.

The cylinder capacity of the smaller engine will therefore be:

$$\frac{80}{75} \times \frac{2500}{3500}$$

or 75 per cent of the larger one.

Forty cubic inches per cylinder, therefore, comes down to 30 cu. in. per cylinder for the same horsepower developed.

These figures are naturally only illustrative but do indicate the possibilities. Since the torque varies as the cylinder capacity, it follows that clutch, transmission universal joints, etc., can be correspondingly reduced in size.

As to how far the process of increasing engine speed can be continued, it is difficult to say.

The modern ultra-high-speed engine is assuming the form of a 100 hp. valve gear and carburetor mechanism grafted onto a small cylinder and is apparently overstepping the ideal of minimum weight per horsepower. In this connection, however, the modern double sleeve valve engine has most extraordinary possibilities and will in all probability dominate the high-speed engine situation for automobile purposes. This mechanism is capable of maintaining substantially constant and very high i.m.e.p.'s up to speeds of 5000 r.p.m., the combustion chamber shape is almost ideal so that the problem resolves itself into one of lubrication and bearing design to withstand these high speeds continuously.

Now as to the relative economies of the high speed vs. the lower speed engine. At full throttle the smaller the cylinder unit the higher the speed at which it must be run to give the same efficiency as with a larger cylinder, but such increase of speed is implied in its general application to an automobile where the smaller the engine, the lower the gear ratio for a given performance.

At part throttle, i. e., the average running condition, the improved economy by using a small engine is more due to the reduced weight of the whole automobile than to any improvement due to increase of revolution speed, although there is a slight but distinct advantage in this respect. In any case, the matter of improving part throttle efficiency may well receive some serious attention from investigators. It is in general very far from what it should be, and as the losses are not to be accounted for on the lines of ordinary thermodynamic reasoning, there is ample ground for the view that some slight modification in existing constructions may produce marked results.

Cost of Production Less

As to cost of production, this is determined primarily by the weight of material used, no increase in the number or complexity of machining operations is necessarily called for, so that the high-speed engine should be produced much more cheaply than the low-speed type.

The outstanding point is that of mechanical reliability and long life. It is axiomatic with machinery

in general that it is the "speed that gets it." Nevertheless, we have progressed far in this matter of increasing engine speed with a definite increase in reliability and there is no obvious reason to assume any limit inside known possible engine speeds. The ultimate economic engine speed depends primarily upon the limits of bearing pressures and speeds and the capacity for heat flux in cylinder and piston design. In each of these considerations, light alloys with their high conductivity and rigidity for a given mass are destined to play increasingly important parts.

Matter of Valve Operation

Of secondary, but nevertheless great, importance, is the matter of valve operation, and in this respect, as already indicated, the double sleeve system has already achieved results which are sufficient to take care of the situation for a good many years to come. In the writer's opinion, the high speed engine, i. e., that engine which can maintain its power for short periods at 4000 r.p.m. and continuously at 3000 r.p.m. is the up-to-date engine of the present, while the next five years should see these speeds put up somewhere between 500 r.p.m. and 1000 r.p.m. The impelling forces to this end are the necessity for meeting competition in regard to price on the one hand, and the demand for economy of operation on the other. These go hand in hand with the development of the high-speed engine. It is cheaper to manufacture because it is smaller and because of the reduction in weight of the engine itself, and the reflection of this throughout the chassis reduces total weight and fuel consumption. This latter, with fuel at 18 cents a gallon, may not seem important, but the measure of the destructive forces in an automobile is the amount of fuel consumed per hour and this item in effect measures the amount of cylinder and piston wear, work done on and by the clutch, transmission, tires, and brakes, and the necessity for repairs and adjustments generally.

Further, the development of the eight-cylinder engine, or in general the small cylinder unit logically brings increase of engine speed in its train.

With regard to public service vehicles, the necessity for economy of operation combined with absolute mechanical reliability is making the slow speed four-lunged thumper an obsolescent type to be replaced by the free running, high-speed, six-cylinder engine.

Regarding silence of operation, it may be said that mechanical silence is a primary evidence of mechanical reliability. Noisy mechanisms are notoriously unreliable in detail if not in general. High speeds necessitate a meticulous attention to detail design to insure silence, and this very fact brings about a potential reliability which more than justifies the effort expended.

In a word, the high speed engine has to be silent to satisfy the purchaser, while the low-speed engine can just get away with a standard of silence which still allows a loop-hole for the entrance of many minor but none the less annoying defects.

None of the provisions for insuring silence call for more than the necessary accuracy of workmanship and limits of ordinary automobile engine manufacture.

They do, however, call for skilled design, a realization of the essential principles underlying design in general and in detail, particularly in regard to the distortion of parts under load. More than ever does the high-speed engine call for design in terms of stiffness rather than of strength and for an appreciation of the modern work on lubrication so ably investigated by modern research workers.

Dealing more specifically with the ordinary stock car, the question arises as to whether there is a speed beyond which it is undesirable to go. Technically there seems no upper limit, but technical considerations are not everything. The speeds of the modern racing engine, which are in the order of 6000 r.p.m., may well be outside the desirable and immediate needs of ordinary engines. There is, however, ample room for a profitable development of the standard type of engine to bring it up to the speed of known first-class engines.

While airplane engines with cylinder units of $5\frac{1}{8}$ in. bore and $6\frac{1}{4}$ in. stroke, such as the Curtiss, have rated speeds of 2500 r.p.m., there is plenty to shoot at in the way of engine speed with cylinder units of 20 to 40 cu. in.

Many existing engines are claimed to peak at 2800 to 3000 r.p.m. and doubtless have this speed capacity. It is doubtful, however, as to the degree of reliability which would be realized if driven continuously at this speed.

The suggested aim is rather to produce a smaller engine which will in fact run at 3000 r.p.m. as satisfactorily as existing engines run at, say, 2400 r.p.m., these smaller engines having a "flash" speed when required of 3500 r.p.m.

Lower Gear Reductions

Such engines naturally call for lower gear reductions in the rear axle so that the conventional 4.5:1 axle will become 5.5:1 for the same or improved performance, a tendency which should bring the worm gear into its own.

In conclusion, the first step toward the realization of the advantages of the high speed engine is to make existing engines perform continuously at the speeds of which they are now capable for short periods. The next is the scaling down of the cylinder unit size and incorporation in the new design of the experience thus gained.

There seems an increasing disposition on the part of the public buying to accept the high speed engine and in this disposition, which may easily be turned into a positive demand, lies a distinct opportunity for the automobile engineer to show the world some real engineering.

Engineering Problems in Truck and Bus Design to Meet Weight Restrictions

By
Edmund
B. Neil

Limitations imposed by various states point to need of lighter and stronger parts for chassis and bodies.

LIMITATIONS imposed by the various states on the gross weight of trucks and buses seem destined to offer new problems for the designing engineer in the commercial vehicle field. A study of this situation leads to the conclusion that chassis and body weights may have to be reduced in the designing room to meet the restrictions economically.

The typical 5-ton truck with a gross weight of 21,350 lb. cannot be operated in states having a limit of 20,000 lb. or less, and these represent 29.3 per cent of the registrations. The 22,000-lb. limit is crowding close to the 5-ton unit, and this represents over 38 per cent of the market.

Under present laws, the 7-ton truck cannot be operated in states representing more than 53 per cent of the market as measured by registrations.

These are the conditions existing today and surely they indicate that chassis and body weight reductions are desirable.

From the standpoint of the engineer, what may be expected? Is further reduction of weight possible without approaching a dangerous condition, and without sacrificing stability and life in service? Must weight reduction necessarily imply a decrease in the useful carrying capacities of either buses or trucks? That weight reductions can be made without reducing strength or carrying capacity are indicated from studies made and reports received from several quarters.

For some years there has been a decided tendency toward increases in the chassis weights of various sizes of trucks and buses, more particularly the heavier types. Bus weights have increased approximately 20 per cent since 1921 and body weights are now 50 per cent higher. Whereas, for instance, the weight of a heavy-duty truck chassis was around 7800 lb. some 10 years ago, this has been slowly increased from year to year until the maximum has exceeded 10,000 lb. for some makes. Some of this increase has been the result of additions in the way of more elaborate equipment, such as inclosed cabs, towing equipment, electric lighting and starting apparatus, etc., but much is the result of additions made to the many

individual parts constituting the assembled unit. Driveshafts, brackets, axle parts, etc., combined with increases in the cross sections of frames and supporting members have all contributed to the total. The same has been true of the motor bus, though possibly to a lesser degree.

These increases appear to have been the result of the adjustment necessary to establish the useful carrying capacities demanded by the vehicle operator or purchaser, and the determination of what must be accepted by the manufacturer as an overload in regular service.

That these increases have reached a point of far greater stability than heretofore is indicated by the large range of sizes offered by truck makers, and the careful establishment of the passenger carrying limits of the types of buses now offered to this market.

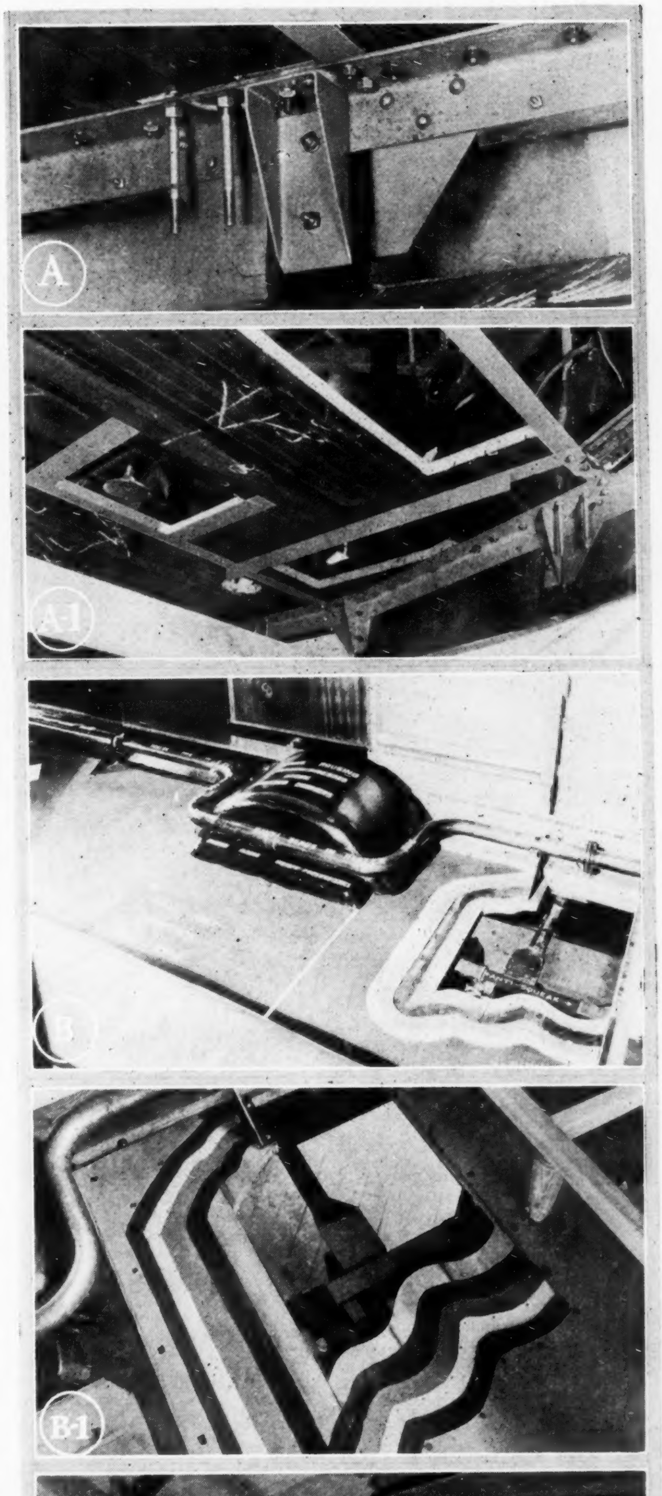
Manufacturers now know what their vehicles can safely carry without too rapid depreciation from overloading. They have realized that every pound of weight added to their units not only increases their cost (out of proportion to total due to major value of cost of materials in the final product), but also penalizes the truck or bus owner in the weight he can carry when the larger sizes are considered. Both react against prospective sales and against customer satisfaction.

And since the greater the useful or pay load in proportion to the weight of the chassis and body, the more economical the entire unit is to operate (assuming of course that maximum loads are to be hauled), the factor of economical operation of the larger sizes of vehicles is not to be overlooked. Hence in addition to compliance with legal restrictions, the manufacturer has other reasons for keeping the gross weights of his vehicles as low as possible.

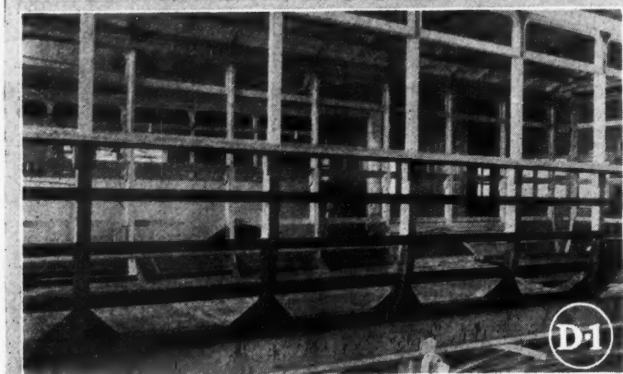
Granting then that weight reduction is desirable, just where can it be made, and with what result? The manufacturer of a well known make of motor bus recently stated that his engineers had been able to reduce the gross weight of his chassis nearly 2000 lb. with no sacrifice in strength or other desirable features. This reduction had been made by careful study of each individual part in the assembly and redesign wherever it was found that even a small amount of weight could be removed. No part was considered too small to be overlooked.

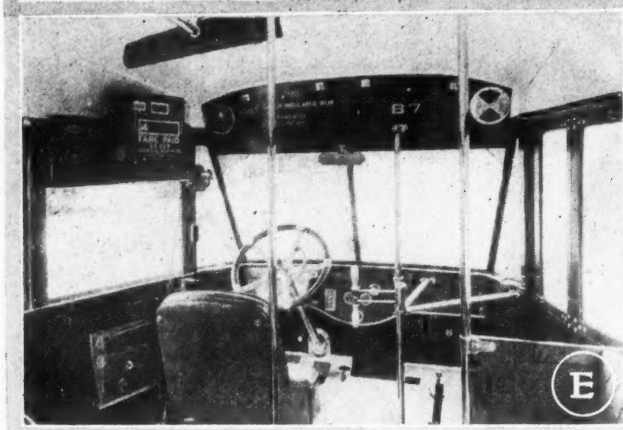
The result was eminently satisfactory for not only were costs reduced but a far better balanced and proportioned job was produced.

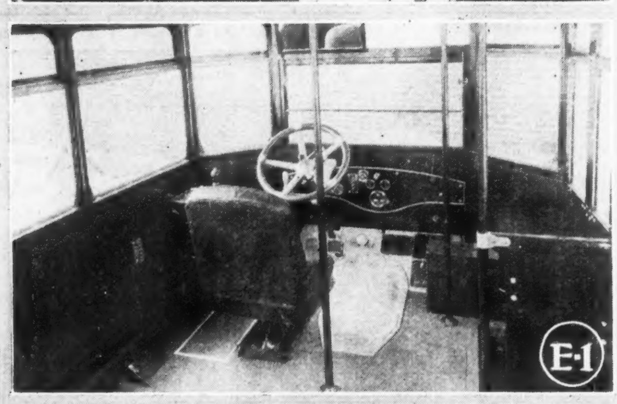
An essential part of this study was that the body was considered as a part of the entire assembly rather than the chassis alone, a factor well worth consideration by some truck and bus makers who pay little attention to the size or weight of the bodies used on their vehicles, other than to establish an oftentimes impractical maximum weight for this essential part of the product as it reaches and is used by the customer. This in turn suggests closer cooperation between the body builder and the manufacturer, which, while now present to some degree, is far from being

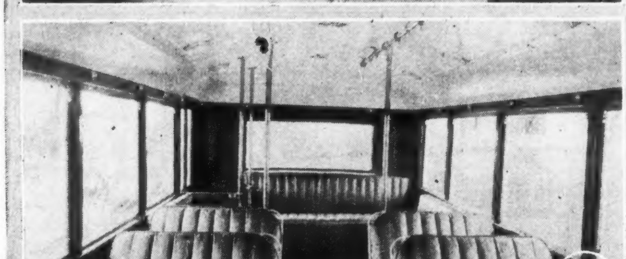


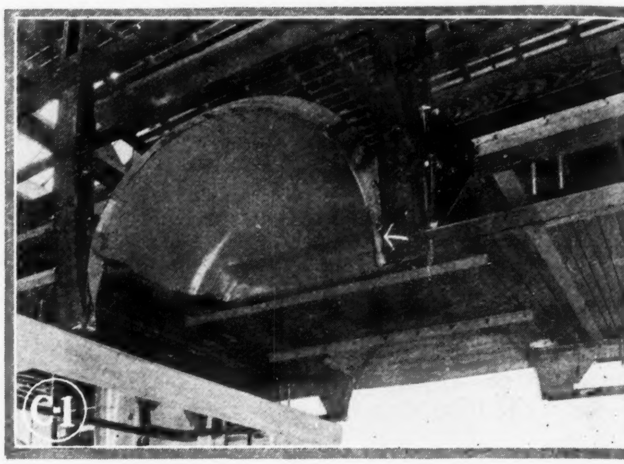
(A). Light channels for bus body sills. (A-1). Under side of body flooring. (B). Section through floor showing method of attachment to frame. (B-1). Detail of section shown in B. (C). Roof and side pillar construction











(C-1). Aluminum wheel housing with angle-iron support. (C-2). Under side of floor frame showing attachment of wheel housing to body sill. (D). Rear corner of body frame. (D-1). Outside of body frame showing post braces. (E). Close-up view of driver's compartment. (E-1). Driver's compartment showing aluminum floor plates. (E-2). Rear view of interior body

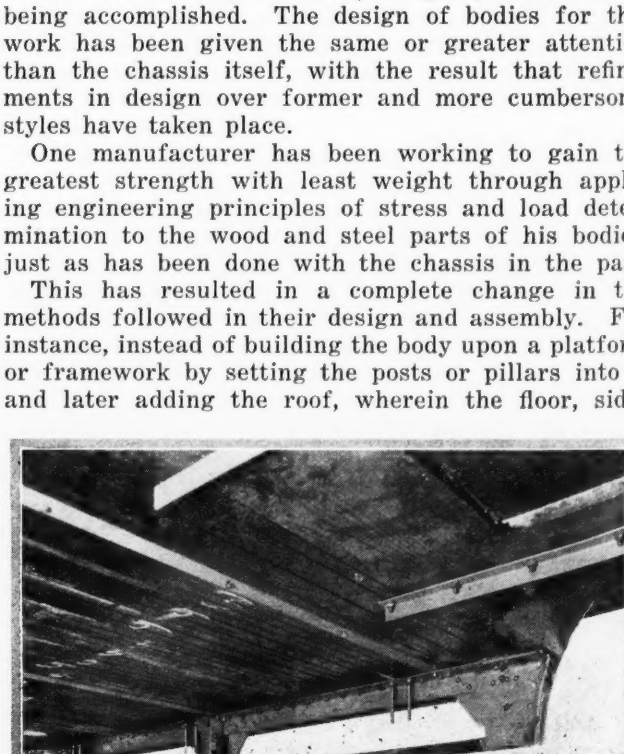
as close as might result in better proportioned vehicles.

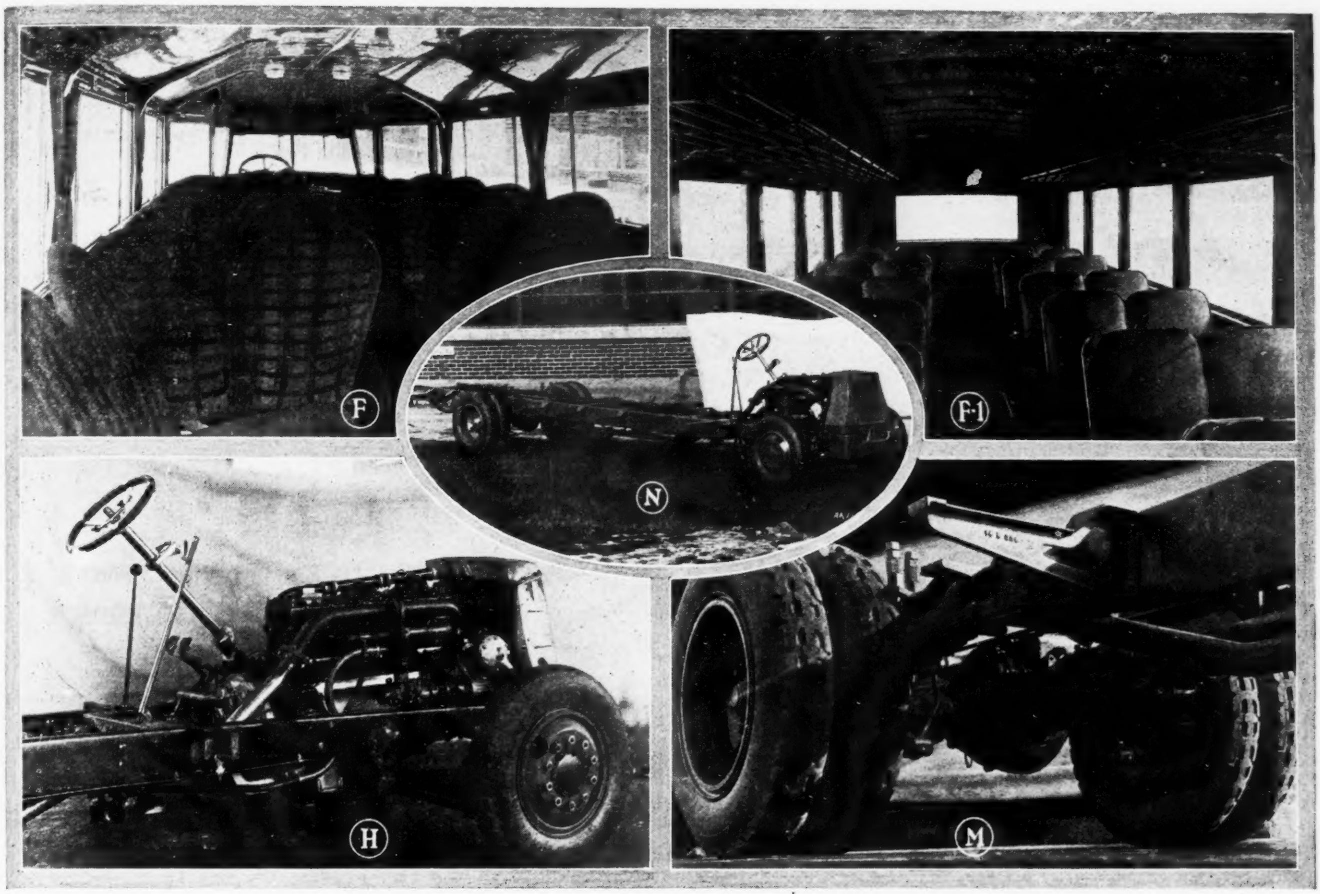
A recent survey of the activities of several motor truck and bus manufacturers has brought to light many interesting facts regarding the extent to which plans for preventing further increase in weight, and in many instances to actually reduce it, have been carried out. Some of these may be noted in the accompanying illustrations.

With reference to bus body weights, much is now being accomplished. The design of bodies for this work has been given the same or greater attention than the chassis itself, with the result that refinements in design over former and more cumbersome styles have taken place.

One manufacturer has been working to gain the greatest strength with least weight through applying engineering principles of stress and load determination to the wood and steel parts of his bodies, just as has been done with the chassis in the past.

This has resulted in a complete change in the methods followed in their design and assembly. For instance, instead of building the body upon a platform or framework by setting the posts or pillars into it and later adding the roof, wherein the floor, sides





(F) Aluminum body with aluminum seat frames. (F-1) Rear of body interior showing aluminum baggage racks and seat handles. (H) Mack bus chassis showing aluminum radiator shell and other aluminum parts. (M) Malleable iron outriggers with web removed to reduce weight. (N) General view of Mack six-cylinder bus chassis

and top are each self-supporting and sufficiently strong to stand alone, the entire unit has been corelated and developed from a cylindrical or box-like structure into a unified whole, tremendously strong when assembled, but no part being very capable of supporting itself without the attachment and aid of the other parts. The floor has been made extremely light, as have been the side and rear panels, and at the same time the roof has been developed with similar strength so that it performs a definite function in carrying its share of the twisting stresses met with in bus operation.

Steel gussets and braces have been engineered into the body at all points where calculations show that they may be needed, but no wood or metal has been used where need for it has not been definitely shown. Tensile strength and bending stresses have been calculated for all important members of the assembly and size of material worked out accordingly. Some of the most important points where engineering has been applied to details of body design may be listed as follows:

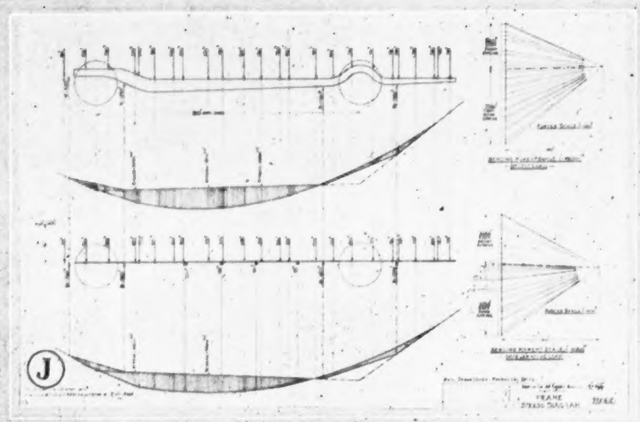
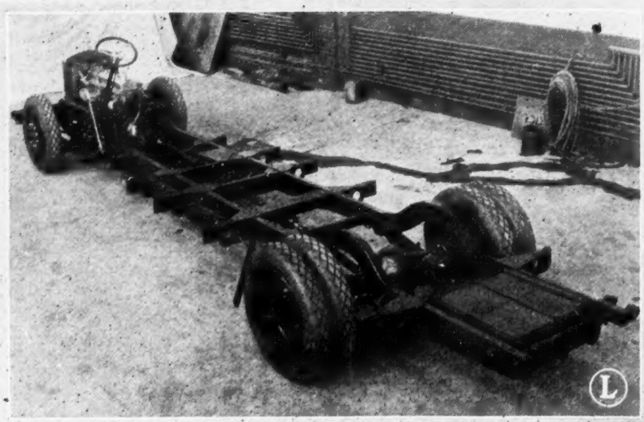
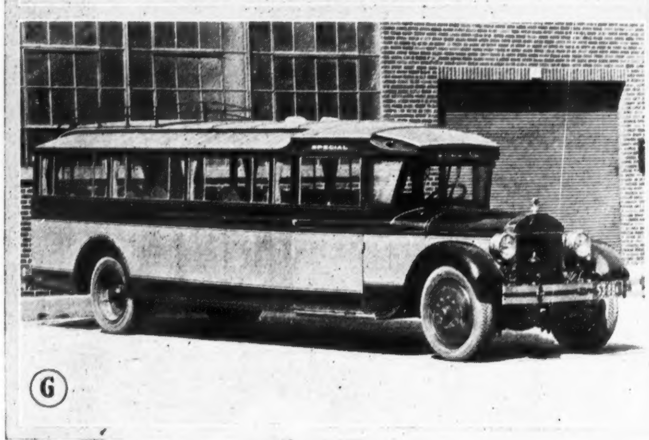
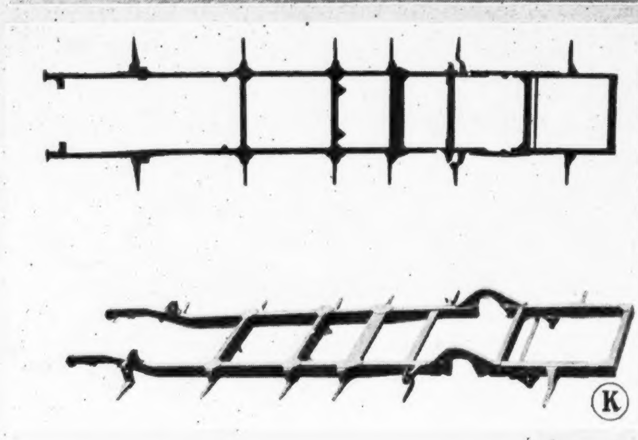
1. Light channel steel frame for floor and body sides (Figs. A and A-1).
2. Attachment of frame to outriggers and body floor resting directly on chassis frame (webbing between floor and chassis frame) (Figs. B and B-1.)
3. Use of angle steel for wheel house support instead of wood block combined with aluminum

Edmund B. Neil

MR. NEIL, author of the accompanying article, spent seven years in engineering work with the Pierce-Arrow Motor Car Co., mostly in the truck department where he specialized in design and development of bodies and in handling sales engineering problems. During the war period he was engineer in charge of production of Army vehicles.

After leaving Pierce-Arrow in 1922, he joined the American LaFrance Fire Engine Co. of New York and had charge of the development of its truck sales organization.

From 1924 to 1926 he carried on consulting work in New York City. At present he is research engineer of the Chilton Class Journal Co.

(J). Stress diagram of chassis frame. (L). Chassis frame showing supports and outriggers. (G). Aluminum body build by American Body Co. (K). Upper: Original design of frame. Lower: Redesigned frame of greater strength and lesser weight

wheel housing (Figs. C and C-1 and Fig. C-2).

4. Extensive use of light stamping for post braces and gussets at top, bottom and corners of body (Figs. D and D1).
5. Use of aluminum for hand rails, stanchions, braces and other interior fittings (Figs. E and E1 and Fig. E2).

Use of aluminum for seat handles, frames, backs, etc. (Fig. F). Also for baggage carriers (Fig. F1).

7. Manufacture of roof as a complete self-supporting unit, thus making it carry its share of total load.

That the above refinements are by no means all is shown by the recent development of the "all-aluminum" body built by the American Body Co. in conjunction with the American Aluminum Co., in which over 90 per cent of aluminum is said to have been used in its construction (Fig. G). Practically the entire structure is of this material, and the design is of the latest type for de luxe service. This body is approximately 1400 lb. lighter than others of similar type and carrying capacity.

Chassis Weight Reduced

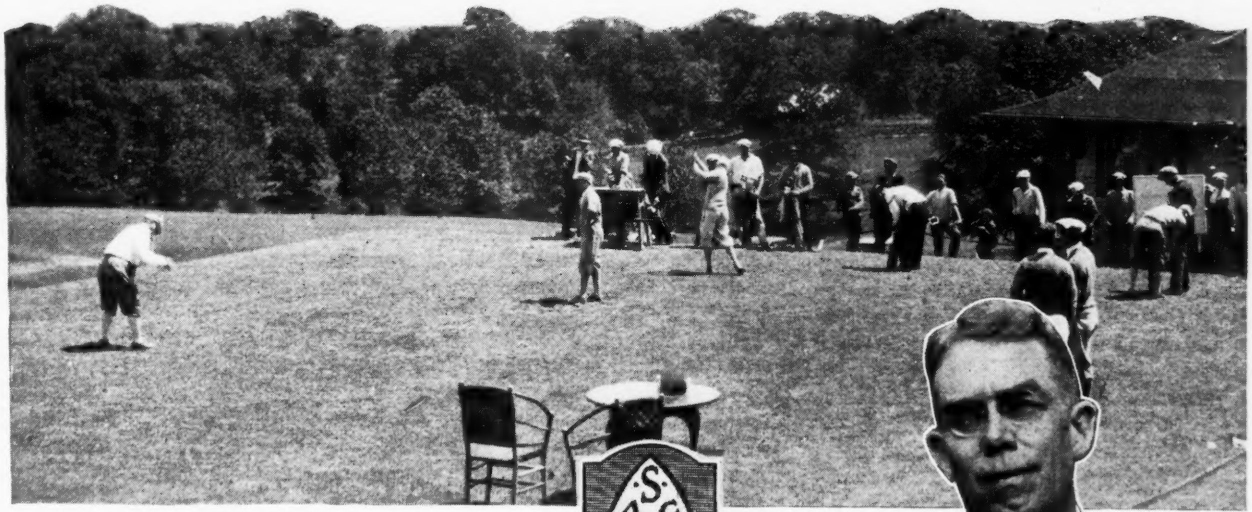
That the possibilities for weight reduction in buses are not limited to the body alone may be noted from refinements found in the latest type of chassis, wherein the further use of aluminum is made for radiator top and bottom tanks and side supports, water pump casings, cylinder heads, water inlet and outlet manifolds, etc., in addition to the usual points where this material is commonly used (Fig. H).

Bus chassis frames also have been given considerable attention. Stress diagrams have been developed with resultant effect upon design (Fig. J). The result of work of this kind is indicated by the two frames, Figs. K and L representing the "before and after" states in this development. The new frame has a depth at the point of maximum stress of 11 in. as against 8 in. in the old one. The stock is the same thickness in both frames, yet it is estimated that the new type is approximately twice as strong as formerly.

Lighter but Stronger

In spite of this increase in strength, the weight of the later type is about 100 lb. less. Frame outriggers, cross members, fish plates and other frame parts have been given attention. Lighter and more carefully proportioned cast sections have been developed (Figs. M and N). Every detail throughout the chassis has been studied, the tendency in some quarters being to add stiffness to the frame to permit of lightening the structure of the body through the reduction of the twisting stresses ordinarily imposed upon it. It has been found that weight can be kept down in this way without sacrificing strength.

Whether or not weight restrictions in themselves may later be responsible for reduction in the overall weight of trucks and buses, the fact that each pound of dead weight removed permits an increase in useful load is alone worth the effort. Decreased fuel consumption, lower operating costs without sacrificing life in service, and other economic factors are all resultants of work in this field. These results are certainly worth while.



S. A. E. *Summer* *M*EETING

Over 800 attend interesting sessions at French Lick Springs. Numerous engineering topics are debated. Col. Wall is nominated for president.

By Norman G. Shidle

PRESENTATION of results of recent researches in fuels, engine acceleration, lubricants, spline-fittings and various phases of engine performance; some difference of opinion about the immediate commercial future of four-speed transmissions, a strenuous argument about whether one or two adjustments should be used for headlights, and a discussion of the relative value of metal brake shoes and friction lining constituted the chief technical features of the annual summer meeting of the Society of Automotive Engineers, held at French Lick Springs, Ind., May 25 to 28.

Nearly 800 members and guests were present, and most of the sessions were well attended.

Col. William Guy Wall of Indianapolis was nominated as President of the Society for the year 1928, while W. R. Strickland, Cadillac Motor Car Co., was selected as first vice-president. Second vice-presidents representing the various divisions of the Society's activities were nominated as follows: Dr. H. C. Dickinson, representing motor car engineering; D. P. Davies, representing tractor engineering; L. M. Woolson, representing aeronautical engineering; Harry T. Woolson, representing marine engineering, and C. R. Schuler, representing stationary internal combustion engineering. C. B. Whittelsey was renominated as treasurer and E. W. Templin, F. G. Whittington and J. W. White were chosen as councillors to serve two years.

William Guy Wall

COLONEL WALL has been nominated to be president of the S. A. E. for the year 1928. While chief engineer of the old National Motor Vehicle Co., he put on the market one of the first six-cylinder cars and designed all of the National racing cars including the one which took first place at Indianapolis in 1912. Early in his career he assisted in changing from steam to internal combustion engines the powerplant of the first American submarine, the Plunger.

He was graduated from Virginia Military Institute in civil engineering in 1894 and from Massachusetts Institute of Technology in electrical and mechanical engineering in 1896.

At present, Col. Wall is a consulting engineer in Indianapolis, Colonel in the United States Reserve Corps and Chairman of the Army Ordinance Advisory Board.

While there was plenty of interest in a majority of the technical sessions, some of the informal discussions around the lobbies and dinner tables as well as one or two subsidiary meetings held during the convention offered unusual interest this year.

Due perhaps to the imminence of the Indianapolis race, there was a great deal of talk among the engineers about racing in general and stock car racing in particular. A good many of the technical men seem to be evidencing considerable interest as well in high compression heads for engines for use with the various high-

test fuels which have gained such widespread distribution in the last year or so, and it seems certain, if unofficial conversation is to be trusted, that a number of prominent car makes will be offering such heads on some models, as optional equipment at least, within the next eight months.

Of the topics under discussion at the sessions proper, four-speed transmissions seemed to arouse the most vigorous interest. It seems evident from indications brought out during the convention that several four-speed transmissions are rapidly being developed in addition to the several which have had such considerable attention in recent months. Just how far this development will advance commercially, few of the technical men cared to predict, but it was quite evident that almost every passenger car engineer at the meeting was interested to know exactly what is going on in this field.

Body Design Developments

Growing partly out of the paper on body design prepared by A. E. Northup, and read by L. C. Hill of the Murray Body Corp., informal talks on the future trends in body development were easy to start around the hotel. While practically no formal discussion followed the presentation of the paper itself on Friday evening, there were plenty of passenger car engineers ready to predict that comfort and appearance features of bodies are going to be among the most important of design considerations during the coming year. Entirely new lines are predicted on several cars, while a definite effort toward originality rather than contentment with following some existing lines seems to be under way in several parts of the industry.

The absolute necessity of combining comfort with style seems now to be pretty generally recognized and the almost universal opinion about the meeting seemed to be that types which are lacking in either one of these essentials are likely to be changed before long.

Superchargers didn't make their way into the formal discussion of the technical papers to any extent, but must also be listed among the topics which the engineers individually were found to be talking about. Several important companies already are known to be working seriously with superchargers and at least one or two supercharged stock models by the time of the next New York show wouldn't be at all surprising.

Expression of opinion about car racing, while constant throughout the meeting by various persons centered chiefly in the meeting of car engineers called by the American Automobile Association at which Capt. E. V. Rickenbacker, chairman of the A.A.A. contest board, presided on Wednesday. F. S. Moscovics, president, Stutz Motor Car Co. of America, and E. L. Cord, president, Auburn Motor Car Co., were the chief speakers at the meeting. Only two other passenger car manufacturers, Studebaker Corp. of America and Marmon Motor Co., had representatives at the meeting so far as could be learned.

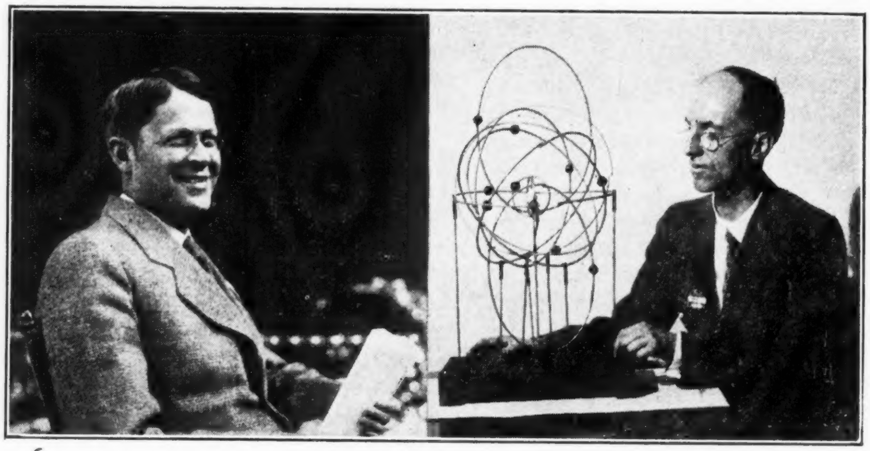
Mr. Moskovics emphasized the necessity for truth in advertising and urged that companies making various claims of speed and performance be made to prove those claims in public competition. Stock car racing, he believes, offers one excellent way to prove such claims. He spoke specifically of several instances in which, by inference at least, the public has been misled by advertising as regards specific performances of certain automobiles and pointed to the desirability of making A.A.A. penalties quick and public for misrepresentation of results of A.A.A. supervised tests or trials.

Mr. Cord admitted some question to be in his mind as regards the desirability of stock car racing, especially from the standpoint of the larger manufacturers and urged very strongly that when stock car racing rules finally are drawn they be so designed as to gain the approval and cooperation of a large number of the manufacturers in the industry, since racing, participated in by only a few, cannot hope to bring maximum value.

The group at the meeting finally decided to present the matter to members of the National Automobile Chamber of Commerce, asking a committee to cooperate with the A.A.A. contest board in drafting stock car racing rules upon which the manufacturers themselves could agree.

Of the various technical sessions at the summer meeting, those devoted to chassis, headlighting, research and brakes drew the largest crowds, although the general session on Wednesday evening was unusually well attended. The Saturday afternoon session was not held because of lack of attendance, the papers scheduled for that session being read merely by title. At the general session, Dr. E. F. Barker, University of Michigan, explained the structure of an atom and Dr. C. H. Robertson outlined current economic conditions in China.

Particular interest was evidenced in the discussion of valve spring surge at the engine session in which W. T. Donkin and H. H. Clark, Cleveland Wire Spring Co., presented slow motion pictures which showed that at certain speeds the elements of the spring are subjected to a vibratory motion superimposed upon the forced motion due to cam action, so that although the motion of the bottom turn could be followed by the eye, that of the central turns could not.



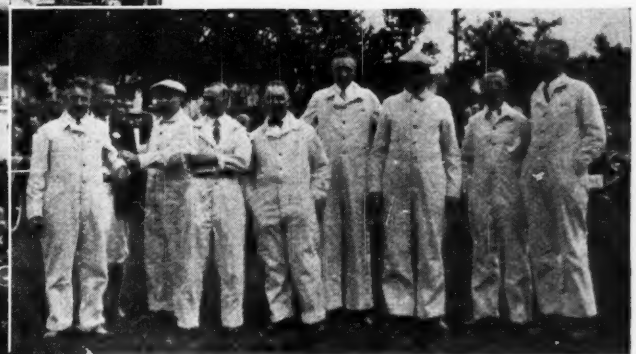
Left—President J. H. Hunt presided at the general session and was active in many of the other technical sessions as well. Right—Dr. E. F. Barker, University of Michigan, explained the structure of an atom at the general session. He is shown here with the apparatus he used to demonstrate the orbits of the various electrons in atoms of different elements

All of the reports of the divisions of the standards committee were accepted at the Standards Committee meeting.

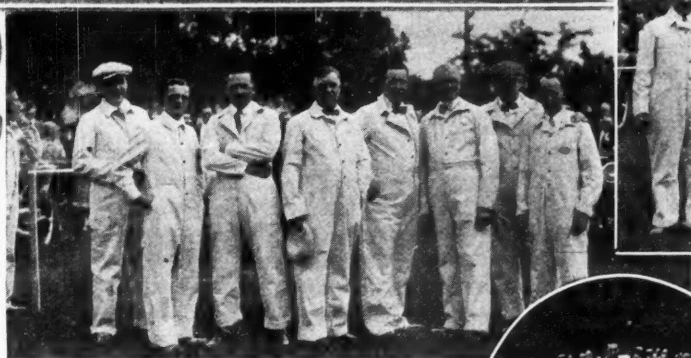
The discussion on four-speed transmissions occurred at the chassis session and is reported rather fully on later pages. At this same session J. H. Hale, Firestone Tire & Rubber Co., talking on pitch, toe-in and castor, said that abnormal front tire wear is brought about by

Rival Teams in the Chassis Assembly Contest

THE chassis assembly contest, which was one of the feature stunts of the S.A.E. Summer Meeting, was won by the Washington Section team, the members of which are seen here aboard the chassis which they put together in record time. Other teams which took part in the contest are shown below.



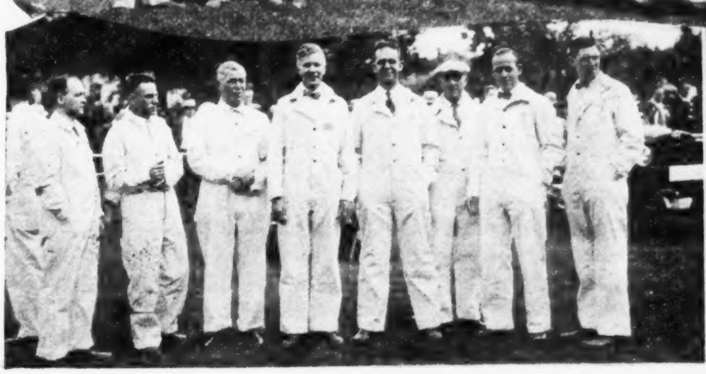
Cleveland Section



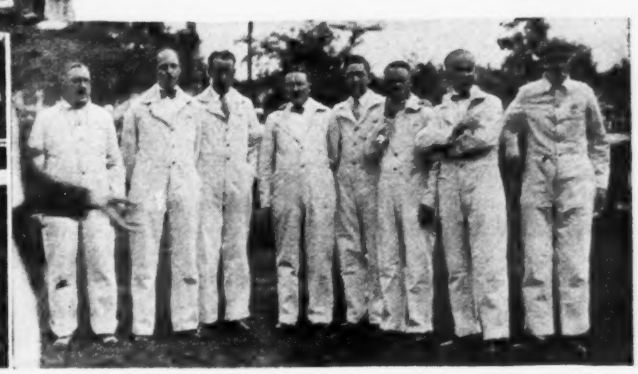
Detroit Section

Indiana Section

Chicago Section



Metropolitan Section



Milwaukee Section

a scuffing action of a complex nature, due to conditions of toe-in, camber or steering link geometry which prevent pure rolling motion.

Closer alliance between industry and the universities was urged at the research session, while a serious debate as to whether metal shoes or fabric linings have the best characteristic for brakes was the chief feature of the brake session.

Golf, tennis, trap shooting and field sports again took up a major portion of the time of many of the conventionites, with golf, as usual drawing by far the largest number of devotees.

A. W. Anderson took first honors at golf when he defeated J. B. Shea in the final match of the championship flight. A new S.A.E. tennis champion was crowned when J. P. Nickonow, Amtorg Trading Corp., won the finals of the men's singles, defeating B. J. Lemon for the title. The tennis doubles were won by J. P. Nikonow and Norman G. Shidle. D. S. Cole and C. T. Klug were runners up. V. W. Kleisrath won th etrap shooting contest and J. T. Greenlee carried off first honors in horse shoe pitching.

Section stunts again formed an important part of the activities of the convention with the Metropolitan Section stunt leading the way this year. A prize which it offered to the members of the Society was won by H. L. Zimmerman. The prize was a Reo Flying Cloud which was selected because its specifications were almost identical with those of the composite car resulting from the Metropolitan Section "ideal car" contest last winter.

The chassis assembly contest, in which each of the sections entered a team to assembly as quickly as possible a number of parts removed from a Chevrolet chassis, was won by the Washington Section team, composed largely of Bureau of Standards representatives.
as could be learned.

Headlights—

Argument Develops Over Number of Adjusting Screws Needed

Some think only one is needed while others favor use of two. Various phases of lighting discussed in four papers.

By A. F. Denham

ON first consideration it would seem a bit out of proportion to spend four hours discussing whether a double-filament headlamp should have one or two adjusting screws, as was the case at the Headlighting Session. However, when it is considered that proper adjustment has a direct bearing on motoring safety, and that there is a very decided difference of opinion on the question even between motor vehicle administrators of the various states, the importance of the discussion can be appreciated.

Four papers were presented at this session. R. E. Carlson and W. S. Hadaway of the Edison Lamp Works had a joint paper on "Factors Affecting Road Illumination," which was presented by Mr. Carlson. "Double Adjustment Headlamps" was the title of a paper presented by W. W. Matthews of the Commonwealth of Pennsylvania. This was followed by a paper on "Focusing Mechanisms and Adjustments" by A. W. Devine of the Commonwealth of Massachusetts; the last paper, by C. C. Bohner of Tung-Sol Lamp Works, was in the form of a discussion on "Fixed Focus Headlamps."

It is the contention of one side in the headlamp adjustment controversy that a single adjustment lamp does not allow sufficiently for variations in filament location, while the double adjustment lamp does. The other side holds that the double adjustment lamp cannot be adjusted by anyone not specially trained; that the average motorist and service mechanic cannot do the job, whereas the adjustment of the one-screw tvpe is pretty well understood.

Mr. Matthews claimed that sufficiently accurate headlamps are not yet a reality and recommended the adoption of the two-adjustment lamp. Continuing, Mr. Matthews also claimed that the vertical adjustment of the single adjustment lamp, which is obtained by means of the standard S. A. E. mounting, is difficult to operate and rarely understood, even when its actual presence is known to motorists.

Following the session, an animated discussion took place in addition to which experiments were made in adjusting headlamps of both types. Charles M. Manly was called on to do the adjusting. Mr. Manly, not being acquainted with the methods of adjustment of either lamp and following instruction sheets issued by a motor car manufacturer. Judging by the results obtained, it would certainly seem that the single-adjustment lamp has the advantage in ease and accuracy of adjustment by the layman.

Would Eliminate All Adjustments

Mr. Bohner suggested that efforts should be made to entirely eliminate all adjustments on headlamps. He stated that the rapid trend toward automatic machine production makes it more nearly possible to produce accurate fixed focus headlamps. The base of the bulb and the socket present the biggest problems. To obviate these, he suggested that a ring be provided on the reflector against which the bulb would seat merely by depressing a plunger after inserting a new lamp. Road shocks and vibration would tend to seat the bulb more firmly. On the question of strength, the tension, according to Mr. Bohner,

R. E. Carlson (top), Edison Lamp Works, General Electric Co., read the paper on "Factors Affecting Road Illumination" which he had prepared in collaboration with W. S. Hadaway of the same organization. Bottom—Dr. H. C. Dickinson came to the meeting with some special headlights for demonstrating purposes and also had with him an instrument for testing riding qualities. Dr. Dickinson presided at the headlight session

need not be more than 3 or 4 lb. while lamp bulb cement is strong enough to withstand 80 lb. Loosening of bases, according to Mr. Bohner, was ascribable more to vibration than to failing in strength of the cement.

In discussing the effect of wet roads on headlight beams, Mr. Carlson said that tests were made under both laboratory and road conditions. As a result of this investigation and actual driving experience the following observations are made:

1. Wet roads change the light distribution materially, resulting in greater glare.
2. Higher light intensities are required to reveal an object on a wet road than on a dry.
3. Increasing the light intensity in a symmetrical system does not give greater revealing power.
4. The use of a non-symmetrical system in which the high intensity portion of the beam is directed to the right of the car axis reduces glare and permits better vision.
5. Adherence to use of 21 cp. lamps has resulted in insufficient light for all requirements. The authors believe that more light could be used to advantage to meet varying road and weather conditions.
6. The use of a very wide spread, low intensity beam near the car in conjunction with a relatively narrow controllable high intensity driving beam appears to possess advantages for both dry and wet roads.
7. With reference to (6), the authors see no reason why fixed focus design should not be used with a somewhat longer focal length than our present standard and employing suitably designed reflectors or lenses.
8. The use of auxiliary driving lights in which the beam is directed to the right of the car axis should be encouraged.•

MR. DEVINE, talking on headlamp focusing mechanisms and how they affect the law, said that in single-filament lamps it is customary to provide one adjustment by means of which the bulb can be moved along the axis of the reflector. No provision for horizontal movement of the bulb at right angles to the reflector axis is necessary, because a sideward movement has practically no effect on the relatively important vertical distribution of light in the beam, and because the effect on the horizontal distribution is negligible.

Three other adjustments are possible, but they involve such practical difficulties that installation of the necessary focusing mechanism has practically never been attempted. One of these adjustments, viz., vertical movement of the filament without rotation, has been approximated by a simple reversal of the bulb in its socket, allowing the operator to select the better of the two beam patterns obtained.

With the advent of the two-filament tilting beam type of headlamp three years ago the question of the advisability of incorporating an additional vertical focusing was brought prominently to the fore. The Massachusetts Registry of Motor Vehicles has not favored the use of more than one focusing mechanism since that construction was first proposed. However, it is not unusual to approve headlamps involving questionable features when data which would justify a final decision on them are lacking; such a course must be taken at times in order not to obstruct development which might result in improvement.

Mr. Devine gave it as his opinion that one focusing adjustment is the limit for practical operation by the motorist or even by approved adjusters.

In the past the manufacturer has not assumed the responsibility which was rightfully his. A requirement of the additional vertical adjustment would shift the burden of responsibility partially from the manufacturer to the user. This movement of responsibility should be in the reverse direction. Headlamps should be placed in the users' hands as nearly foolproof as possible.

Headlamps can be so designed that they will be satisfactory if the center of the filament is located within a certain distance of the focus. This design eliminates the necessity of bringing the light source to the exact focus.

Samples of double-filament bulbs were gathered recently from 40 dealers in Massachusetts. The total number of bulbs was 244, of the following brands: National G. E., Edison, Ever-Ready, Westinghouse, Edison G.E. and TungSol. All were measured carefully. Vertical misplacement of filaments varied from nothing to 0.05 in., the average of all 244 being 0.014 in.

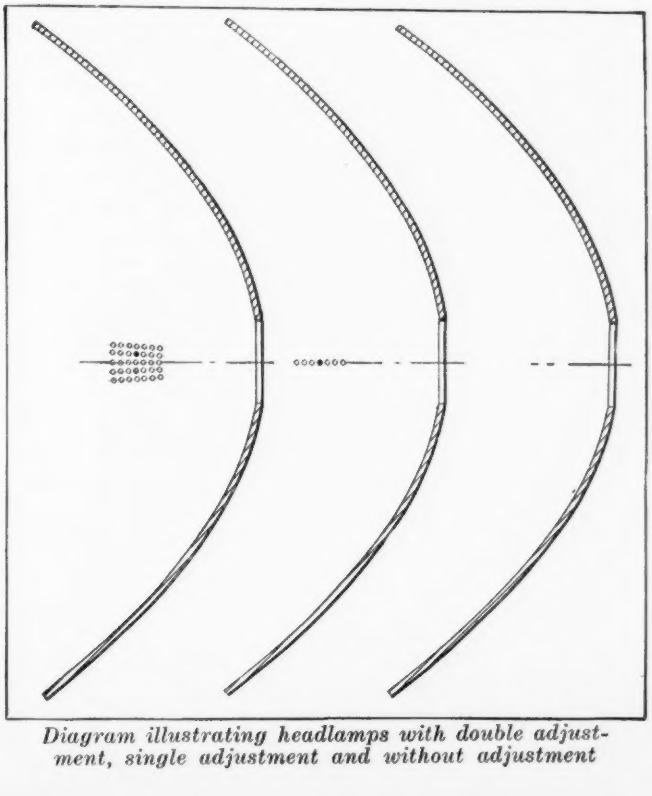


Diagram illustrating headlamps with double adjustment, single adjustment and without adjustment

Chassis—

Wide-Spread Interest Displayed in 4-Speed Transmissions

Extensive discussion follows paper by S. O. White. Effects on tire wear of toe-in and caster are outlined.

By P. M. Heldt

THE Chassis Session on Thursday morning drew a large crowd. E. S. Marks, chief engineer of the H. H. Franklin Mfg. Co., presided. Two papers of timely interest were presented, one on "Pitch, Toe-in and Caster," by James E. Hale of the Firestone Tire & Rubber Co., the other on "Four-Speed Transmissions," by S. O. White of the Warner Gear Co. There was practically no discussion of Mr. Hale's paper but Mr. White's paper was extensively discussed. Much of the discussion being contributed in writing.

Mr. Hale dealt with the effects on front tire wear of pitch, toe-in and what he calls the steering geometry. Front tires, he said often wear abnormally. Cases of such abnormal wear can be divided into three classes, as follows:

1. The center rib or non-skid shows very little wear and the outer edges show a great deal.
2. The center and one outer edge show little wear, while the other outer edge shows a great deal.
3. Spots at irregular intervals around the tire are worn noticeably more than other parts. This is called "cupping" or spotty wear.

Abnormal front tire wear is brought about by a scuffing action of a complex nature, due to conditions of toe-in, camber or steering link geometry which prevent pure rolling motion. As regards toe-in, it is probable that at any given instant only one of the two wheels makes an angle with the direction of motion of the car, and it is also probable that, as a result of changes in the road surface, the error is switched from one wheel to the other quite frequently. "Cupping" or "spotty tread" wear probably is due to this switching of the error from one wheel to the other.

Wear Due to Excessive Camber

With excessive camber the tire runs on one side, which obviously increases the wear on the outer edge. In this case further slippage and wear are caused by the unequal diameters of the center and the outer edge, the former assuming a true rolling motion, necessitating slippage of the latter.

Mr. Hale experimented with a camber of ¾ deg. and a toe-in of 1/16 in., and obtained such good results as compared with those obtained with the larger camber and toe-in commonly made, that he was inclined to recommend these values for consideration as standards. He hoped that a single standard of camber and toe-in could be recommended universally as it would facilitate the realignment of wheels.

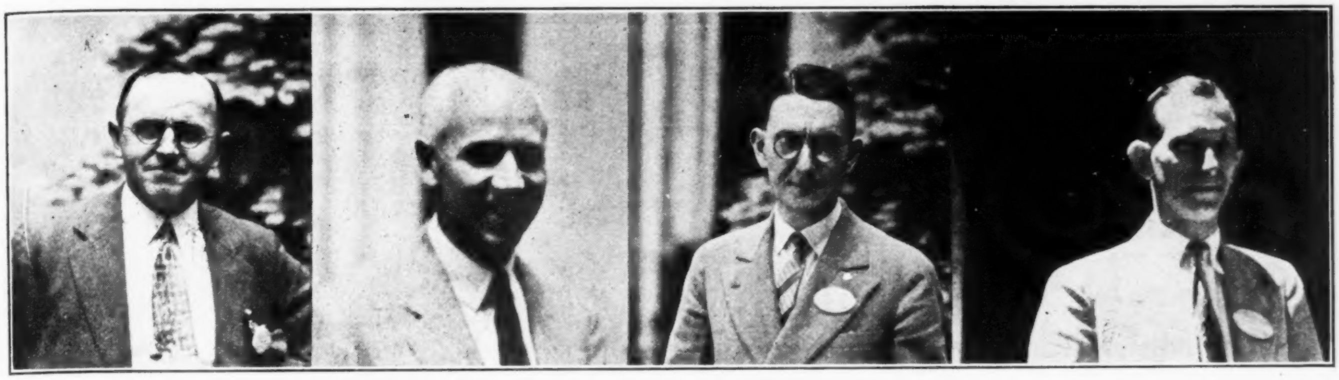
Toe-in is generally considered a corrective for the effects of camber.

In describing turns, scuffing of tire treads may be caused by inaccuracies of the steering linkage, as well as by excessive camber and toe-in. The vertical studies show that no linkage can give pure rolling motion of all wheels for all angles of deflection. Some engineers have attempted to solve the problem of correct steering linkage geometry by placing oiled paper on a vaseline-covered floor, repeatedly pushing one front wheel of the car over this paper and making adjustments in the linkage until no disturbance of the paper takes place. The author said it was his belief that very few cars in owner's hands meet the condition of this test. He recommended expressing the toe-in as the difference in the maximum and minimum distances apart of the front wheels on circles of 25 in. diameter. Accurate adjustment of toe-in is essential and provisions should be made for it. Engineers also should familiarize themselves with the various gages on the market for checking toe-in, as they vary greatly in practical merit.

In conclusion, Mr. Hale said he felt strongly that standard figures for camber and toe-in should be arrived at, if practical. Some research work would probably be required, and it might be found that a formula was needed for each, rather than a standard value.

MR. WHITE'S paper dealt with the Warner Gear transmission which was described in *Automotive Industries* of March 26 last. Mr. White is a strong partisan of the under-geared as against the over-geared type.

Three-way wheel aligner manufactured by A. E. Feragen of Detroit, which was exhibited in connection with the paper on Pitch, Toe-in and Caster



Left to right—Edward S. Marks, chief engineer, H. H. Franklin Mfg. Co., was in the chair at the chassis session where four-speed transmissions and other topics were discussed. James E. Hale, manager, development department, Firestone Tire & Rubber Co., talked to the chassis session on "Pitch, Toe-in and Caster." S. O. White, chief engineer, Warner Gear Co., presented a paper on four-speed transmissions. Robert Lapsley, chief engineer, Detroit Gear & Machine Co., was prominent in the discussion of the four-speed transmission paper

The Warner Gear Co.'s first efforts were along the line of an over-geared transmission, the internal gear mechanism being built directly into the gearbox and not a separate unit, as in some of the earliest designs of this type. It soon became evident, Mr. White said, that "while the car with an over-speed transmission performed much better than a standard car, nearly everyone who drove it wanted to drive it at top speed practically all of the time and to use third speed only for acceleration and hill climbing.

"The fundamental purpose of this whole program, it should be remembered, is to reduce vibration. The overspeed reduced the engine vibration by permitting the engine to run slower, but it did not decrease vibration or whip of the propeller-shaft, and propeller-shaft vibration can, and usually does, cause almost as much disturbance as engine vibration. Furthermore, with this construction the transmission was driving through gears nearly all the time, which seemed illogical. The internal gears run very smoothly and are remarkably efficient, but they are not perfectly silent and are not 100 per cent efficient. Furthermore, this internal gearing was rotating faster than engine speed, which presented both bearing and lubrication difficulties to solve."

In opening the discussion on the White paper, Chairman Marks said there was probably considerable difference of opinion as to the best method of assuring the utmost riding comfort at 50 m.p.h., whether it should be done by an additional geared speed or the use of a larger engine. C. S. Crawford said in his opinion the sales department, before urging the adoption of four-speed gears, should educate the driving public to shift gears.

He would rather spend the money that was put into the development of four-speed gears in the improvement of three-speed gears.

Robert Lapsley of the Detroit Gear & Machine Co. contributed some written discussion in which he generally agreed with the author of the paper. He laid great stress on the positions of the gear shift and recommended that second, third, fourth and reverse positions be arranged the same as the four positions of the present three-speed transmission shift lever with the first speed position latched out. This would make the operation of the gear identical with that of the present three-speed gear, the car being normally started in second. Thus a sales resistance would be eliminated. He also advocated the use of deep splines for the third and high speed clutches, as these clutches would be used somewhat more frequently.

Col. William G. Wall agreed that it was very desirable that there should be one quiet drive in addition to the direct drive. The internal gear unit is one way of securing this quiet drive, but it takes up a lot of room and is expensive to build. All other methods of securing quiet drives should be given careful consideration.

F. C. Thompson contributed to the discussion an article from his pen which appeared in *Automotive Industries* of May 21, and which he read in part.

C. D. McKim of the Hercules Motor Mfg. Co. voiced the opinion that the problem could be solved by using larger engine capacity. American drivers did not want to shift gears. A 4 by 5 in. engine did not cost much more than a $3\frac{1}{2}$ by 5 in. engine and fuel economy was a factor of very low rating. F. E. Moskovics pointed out that in Europe the tendency at present was away from the four-speed gear. He had in mind particularly one prominent maker who turned out a large car with a three-speed transmission and a small car with a four-speed, and the latter was not a success. C. S. Crawford said it was not necessary to fit larger engines but to develop engines so as to get more out of a given displacement.

T. L. Fawick said he had started out with large bulky engines and had gradually come down to smaller ones. At present the tendency was decidedly in the direction of smaller powerplants. He expressed himself very forcibly with respect to the advantages of the four-speed gear, concluding his remarks with the statement that anyone who had ever driven a car provided with a transmission with two quiet driving ranges would no more think of returning to the conventional three-speed gear than he would of driving a car without a starter.

Above, left to right—R. S. Drummond, Thomas L. Fawick, Noble C. Banks, F. C. Thompson, A. J. Scaife, James A. Edwards, H. C. Marble. Right—George R. Gwynne and D. M. Gillespie gave the meeting a bit of Western atmosphere

Brakes—

Relative Advantages of Friction Materials Discussed

Question whether metal shoes or fabric linings have best characteristics debated. Four papers presented.

AN unusually animated discussion of various controversial subjects regarding brake design and maintenance took place at the Brake Session. The subject most debated was whether metal shoes or fabric linings have the best characteristics for brakes. This discussion, which followed a paper on "Internal Brakes" prepared by H. D. Church of the White Motor Co. and presented by F. D. Alborn of the same company, was followed by three papers, S. Von Ammon of the Bureau of Standards discussing "Brake Lining Tests," Alvin M. Yocom of the Multibestos Co. discussing factors affecting normal brake operation, and F. W. Parks of the Cowdrey Brake Tester Organization giving a paper on "Brake Testing and Adjusting."

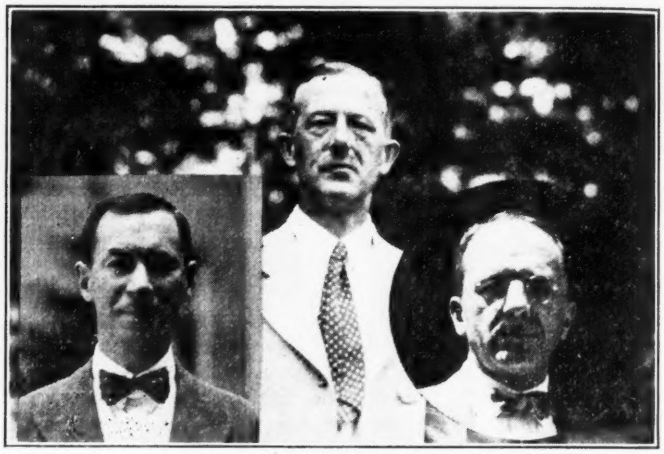
"After almost two years' experience with metal-to-metal internal expanding brakes," Mr. Church's paper stated, "I am very strongly in favor of that construction. There is only one drawback from a passenger car viewpoint and that is the slight noise made by the braking surfaces during operation. So far as that goes, I hear the friction-fabric-faced external brakes on many of the new cars making a great deal more noise than do these metal-to-metal internal expanding brakes."

During the discussion which followed the paper, G. A. Green, chairman of the session, asked Mr. Alborn for comparative data on mileage with metal-to-metal shoes and fabric-friction linings, Mr. Alborn stated that these were approximately the same. Mr. Alborn also stated that steel drums were better for metal-to-metal contact brakes while cast-iron drums are advisable when friction lining is used. This is due to the fact that steel picks off particles of fabric, this condition not being found with cast iron.

Replacement Costs Reduced

It was also brought out during the discussion that Mr. Fageol on his new "Twin-Coach" bus is using metal-lined internal shoes to reduce replacement costs, while retaining the advantages of metal-to-metal contact, the discussion indicating that experience has shown a higher cost of replacement service with metal shoes than with fabric lining.

A summary of brake testing equipment and methods during the past few years at the Bureau of Standards formed the major part of Mr. Von Ammon's paper, which was profusely illustrated with charts and slides of apparatus. Laboratory tests, according to Mr. Von Ammon, are essential to determine detailed brake characteristics, which cannot properly be determined on the road. Such tests should cover both samples of friction lining and the complete brake assembly. Tests over a period of years, according to Mr. Von Ammon, would tend to show that brake drum surface character is not as important a factor in the proper operation of brakes as is the heat generated by the applied brake and its rate of dissipation.



Left to right—Col. G. A. Green, vice-president in charge of engineering, Yellow Truck & Coach Mfg. Co., presided at the brake session. F. G. Alborn, assistant chief engineer, White Motor Co. presented the paper on "Internal Brakes" which had been prepared by H. D. Church, chief engineer of the White organization. F. W. Parks, Cowdry Brake Tester Organization, talked on "Brake Testing and Adjusting"

Mr. Yocom's discussion attacked the brake problem from the service station angle. He summarized all the various factors which might be responsible for improper brake operation or brake noise, such as insufficient lubrication of all movable parts in the brake mechanism, rivets bearing on the drums, road grit or drum rust imbedded in the lining, grease or oil on the lining or a film of water between it and the drum.

Good roads, faster driving speeds, dense population and growing attention to brakes on the part of the public and law enforcement authorities have resulted in making the problem of brake adjustment one of the most serious confronting the industry at present, stated Mr. Parks in his paper on "Brake Testing and Adjusting." The responsibility for the solution of the problem, according to Mr. Parks, rests equally on engineering, production, service, and sales. Mr. Parks also stated that he believed that the tolerances for brake drum eccentricity at present in force are too high. He also recommended a grading of cars as to stopping distance.

MR. CHURCH dealt in his paper with the development of internal wheel brakes for motor trucks and high speed motor coaches. The conclusion was

reached early in the development work that a two-shoe internal brake presented the most practical solution of the problem, even though with this type the aggregate angular length of the brake linings is a relatively low per centage of a complete circle.

On motor coaches the use of 20 in. rims, essential in order to keep the chassis and body low, makes the braking problem more difficult.

1. By limiting the diameter of the drum that can be used.

2. By masking the brake-drum so that the ability of the drum to dissipate heat is materially reduced.

The objects to be attained in connection with the design of a brake of this type can be briefly stated as follows:

1. The maximum degree of self-energization that will not "grab" or give roughness when using a brake-lining having the highest coefficient of friction of any that is obtainable on the open market, in order to obtain sufficient self-energization with the lowest coefficient of friction to be found with any brake-lining that is likely to be obtained.

2. Ample braking effect and ability to hold equally well with either direction of drum rotation.

3. Uniformity of brake action throughout the life of the brake-lining.

4. Satisfactory life both of brake-linings and drums.

Factors Affecting Self-Energization

The factors affecting the self-energization characteristics of the brake shown in Fig. 1 are as follows, no attempt being made to list them in the order of relative importance:

1. The coefficient of friction of the lining. It is probable that the coefficient of friction of the brake-drum itself also has its effect, but we disregarded this factor as there is little difference in coefficients of friction of the materials suitable for brake-drums.

2. The angle a, having its vertex at the geometrical center of the brake-drum and formed by lines passing through the center of the cam and the toe end of the lining. Within certain limits the greater the angle a the less is the degree of self-energization, and vice versa. Our experience indicates that the brake is very sensitive to variations in this angle.

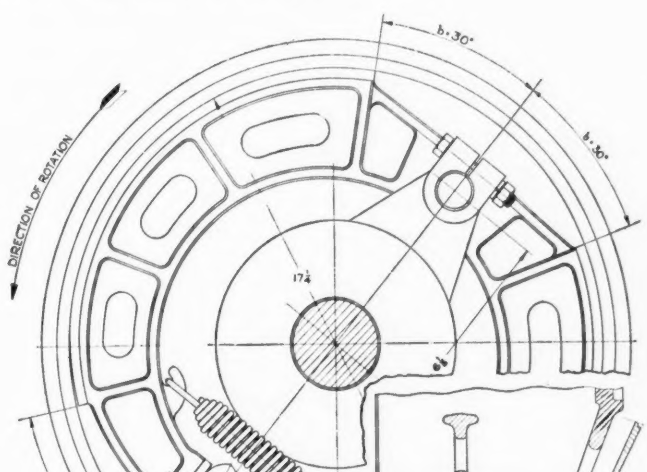


Fig. 1. Details of self-energizing internal brake

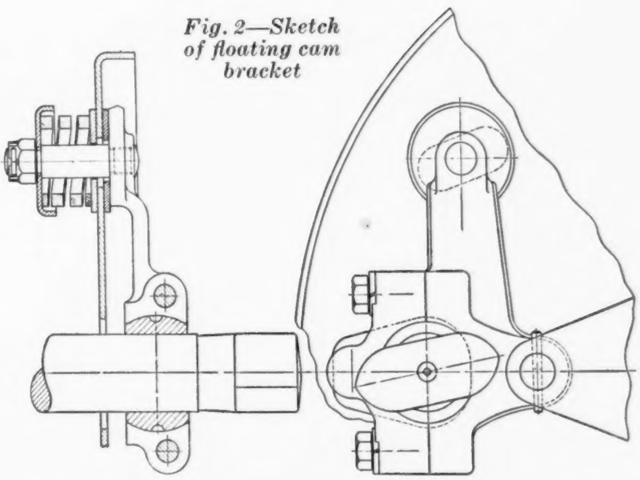


Fig. 2—Sketch of floating cam bracket

3. The corresponding angle b, at the hinge end of the shoe. Variations in angle b are of much less importance than variations in angle a.

4. The ratio between the radial distances from the brake-drum center to the inner surface of the brake-drum and to the hinge-pin center, $6\frac{1}{8} : 8\frac{5}{8}$ in this case. This ratio, like angle a, has to be held within close limits because it has a major effect on the degree of self-energization.

5. The resistance of the brake-drum to distortion. With a high degree of self-energization, the tendency to spring the brake-drum out of round is very great.

6. The resistance of the brake-shoes to distortion, as a result of either force or heat.

The brake drum is of heavy section and reinforced by circumferential cooling ribs, and the brake shoes are of very rigid design. It was found necessary to skive off the toe end of the shoe surface, to make sure that when everything is new contact cannot start at the extreme end of the lining, which would result in extreme self-energization.

Directions of rotation of brake drum and camshaft should be as indicated in Fig. 1, which assures that the frictional drag between the cam and the self-energized shoe tends to deflect the toe end of the shoe from the drum, instead of toward it, thus preventing grabbing.

The lining of the self-energizing shoe wears much faster than that of the other, and to prevent loss of brake power from this cause, the cam is mounted on a floating bell crank, which enables it to change its position. At the end of this bell crank opposite the cam there is a frictional device at which there is sufficient friction to prevent the whole assembly from dropping into contact with the drum under the influence of road shock when the brake is released, but not sufficient to prevent the automatic adjustment of the shoes when the brake is applied.

Dimensions given in the drawing relate to the brake used on the White 16-21 pass. coach. The lining is 4 in. wide. Rear tires are 34 by 7.50 in., low pressure, with a loaded rolling radius of 16.76 in. The allowable gross weight is 13,000 lb. and the coach is capable of 50 m.p.h.

IN the United States, 22,000,000 or more people have been provided with motor vehicles, said Mr. Parks in his paper on brake adjustment. For the most part, we have spent our best engineering talent toward making these 22,000,000 vehicles run cheaper, faster, quieter, etc. Little attention has been devoted toward making them stop. Until recently there has been no means by which to tell whether or not the vehicle could be stopped within reasonable distance, and what constitutes reasonable distance for stopping has been hazily defined. Our problem is to

develop a science of brakes, that we may thereby improve the stopping performance of 90 per cent of our 22,000,000 motor vehicles.

This problem exists because we have now developed such acceleration for motor vehicles that we must perforce provide adequate and safe deceleration.

We have tested four-wheel brakes on cars at several factories, after they had passed inspection and were ready for shipment. In no instance were they properly equalized and ratioed. In many cars the total available braking force present did not equal that of a good two-wheel-brake car. In no instance did the methods used give uniform results. On some cars as high as 70 per cent of the braking force was found on one side of the car.

We have found in our experimentation that while some systems are properly designed, others have hookups that do not perform as designed. For example, one make of car intended for 55 per cent braking force on the rear wheels and 45 per cent in front, showed by actual test that the larger part of the total braking force was on the two front wheels. We also found one other case where adequate front wheel retarding force could not be produced due to faulty design. The adjustment simply was not there.

We have found many types of adjustment of so coarse a nature as to prevent close equalization. Apparently it has not been always recognized that brake adjustment should be of a micrometer nature. Minor changes of adjustment at the critical point create wide changes in braking effort and great care must be exercised to get just the right adjustment.

Brake drum eccentricity has not been thoroughly studied in all factories with reference to effect on braking effort. In some cases fifteen thousandths of an inch have been allowed for eccentricity. The Society of Automotive Engineers has promulgated a tolerance of .015 in. for brake drum eccentricity for drums 16 and 17 inches in diameter and .010 in. for drums 15 in. in diameter or less. We believe this tolerance too generous. Our experience to date prompts the suggestion to the Society that reconsideration be given to these tolerances. On a vehicle of, say, 3000 lb. weight, this tolerance will produce a variation of 200 lb. braking effort in one complete revolution of the braked wheel. With such a variation, the wheel may readily lock in the same position at each brake application, thus ruining the tire—and it is absolutely impossible to equalize brakes where this condition exists.

Research—

Closer Alliance Between Industry and Universities Urged

THERE have been some statements recently that future developments in the motor car field will come from the research laboratory. That a closer alliance between the university, laboratories and similar institutions, and the industry is necessary to bring research and industry closer together was emphasized by William S. James of the Studebaker Corp. of America at the Research Session. His paper on "Relation of Research to Industry" pointed out that not only would the industry benefit from closer alliance with the universities from a research angle but that it would also be enabled to obtain men from the universities fitted for industrial work through contact with the research departments, thus giving an additional commercial value to a university education.

Following Mr. James' paper H. K. Cummings of the Bureau of Standards presented a paper by D. C. Ritchie, also of the Bureau, on "Lean Explosive Limits for Hydrocarbon Fuels"; "Engine Acceleration Tests" was the subject of a paper by J. O. Eisinger also of the Bureau, while Dr. M. R. Schmidt of the Standard Oil Co. of Indiana discussed "Specifications for Petroleum Lubricants," and C. W. Spicer, of the Spicer Mfg. Corp., presented a paper on "Strength of Spline Fittings."

In discussing Mr. James' paper, B. J. Lemon emphasized the need for eternal research if American industry is to survive. Such research, Mr. Lemon stated, should be applied to all industrial problems, such as depreciation of used cars, advertising, wholesale and retail sales methods, and service contacts.

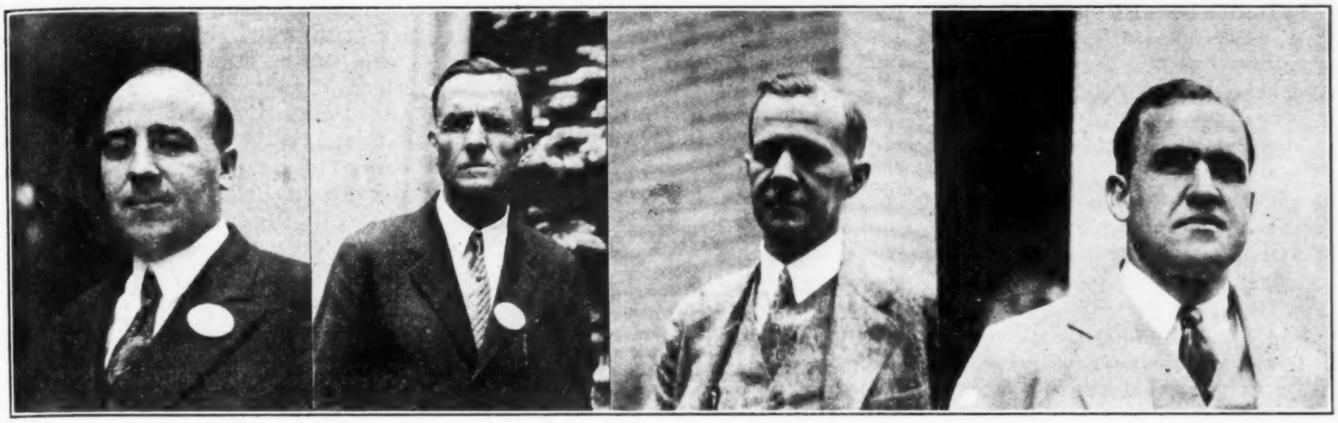
Scarcely one of the large automobile companies has the correct perspective on the present consumption market, David Beecroft of the Chilton Class Journal Co. stated when discussing Mr. James' paper. Forty-eight per cent of all cars sold are marketed in places of 5000 or less. In addition to this, these owners buy their equipment and have their repairs made in these places. Cars should be designed with this in view.

H. L. Horning of the Waukesha Motor Co. added that cataloging of available information was too much neglected. He stated that it is a failing of men to acquire information, hide it so that no one else could find it, and then forget all about it themselves.

Mr. Ritchie's paper on "Lean Explosive Limits for Hydrocarbon Fuels" in general showed that an air-fuel ratio of 25 to 1 can be used for both cracked and straight gasoline.

An Interesting Suggestion

An interesting suggestion was offered by W. D. Clark of the Bureau of Standards in discussing Mr. Eisinger's paper. This was that possibly an increase of manifold area with throttle opening so as to produce constant vapor flow might assist in reducing acceleration problems. Work at the Bureau showed that the velocity of vapor flow between carburetor and cylinder was very important. To demonstrate this a special manifold was constructed, built up of copper tubes and provided with a piston valve uncovering an increasing number of tubes with increased throttle opening.



Left to right—The research session was under the chairmanship of R. E. Wilson, research council, Standard Oil Co. of Indiana. C. W. Spicer, chief engineer, Spicer Mfg. Corp., read a paper on "Strength of Spline Fittings" at the research session. Dr. M. R. Schmidt, Standard Oil Co. of Indiana, made some unusually pertinent observations in his discussion on "Specifications for Petroleum Lubricants." J. O. Eisinger, Bureau of Standards, outlined to the research session the results of recent investigation made by the Bureau in engine acceleration tests

In the automotive industry it has often been said, stated Mr. James, that no time is available for the solution of anything but immediate problems. Continuing, Mr. James said in part: "I believe it is also true that very few people in the industry are considering seriously what problems will confront them one or five years from today. At present there appear to be very few facilities which have been coordinated with industrial activity for the carrying out of research work. University laboratories and similar institutions are the most promising sources. Their contact with industry, however, is limited and their knowledge of future problems therefore weak. A scheme of cooperation with such institutions would produce a twofold benefit. Industry would be supplied with information at an opportune time and men leaving the universities would have a clearer understanding of the problems of industry. One of the possible by-products might be the retention of men in this line. While I do not believe that a university can train a man, it affords a place for the selection of men. If students could work in the university atmosphere but with commercial objectives I believe much good would result."

DR. SCHMIDT, in his paper on "Specification Writing for Petroleum Lubricants," said: By far the easiest method of writing specifications is to analyze a satisfactory lubricant, to the extent of the ability of the plant laboratory, and to embody the results of the analysis in the specifications.

Obviously, specifications drawn up in this way have two serious defects: First, the specifier does not know that the product he is using is the best for his purpose, or all things considered, the cheapest. Second, the value of the specifications in securing what is desired depends entirely on the accuracy and completeness of the analysis and on the ability to sift out pertinent from impertinent items. Proficiency in either of these lines presupposes a wide acquaintance with lubricants in general, and especially with the connection between composition and properties; but such information ordinarily does not reside in the usual plant laboratory or purchasing department.

A second method of drawing up specifications may be termed the "electic method." The specification writer reviews a number of analyses and specifications that appear to have some connection with the problem in hand, and then chooses an item here and an item there as he deems them important. The result is usually a non-existent hybrid which, in the case of oils, may combine a certain low pour-test with an impossible high flash-point, a certain viscosity range with an unattainable carbon test, and so on. In the case of greases, the specifications may call for a lime-soap grease which must have the properties of a fibre grease, or for a fixed-soap-percentage which is incompatible with the desired consistency or with the melting point specified.

The Legitimate Method

The third method of composing specifications, which is the only legitimate method, is to summarize the results of a comprehensive study of each lubricating problem. When such studies are made, it will often be found that narrow limits of viscosity, flash-point, and other features are not necessary in oils, and that exact soap-percentages, oil viscosities and consistencies are not essential in greases.

To arrive at the principles which should underlie all specification writing, it is necessary to consider the primary purposes of these documents. First, they should describe fully the desired product, so that the manufacturer can supply it. Secondly, they should make it possible for the purchaser to determine whether the desired product has been supplied. In short, they must provide accurate characterization and protection. Hence, all clauses in specifications must be pertinent and must be enforceable.

Examples of irrelevant provisions in specifications are seen every day by lubricants companies. One such provision that is seen frequently is the "straight-run" clause. This requires a lubricating-oil must not be a blend of two or more oils but shall consist of a single continuous fraction from the lubricating-oil stills. Such a requirement is equivalent to demanding that an alloy steel shall be turned out direct from the ore. Obviously, neither metallurgists nor petroleum refiners can work under such limitations. No refiner could afford to make separate runs in his stills to obtain a viscosity of 225 sec. for one motor car company and a viscosity of 275 sec. for another company. Nor would either of these companies be willing to pay the prices entailed by small-scale manufacture of such special products.

Other instances of irrelevant requirements are low cold-tests in oils which will never be subjected to

cold, low Conardson carbon figures in oils which will never be subjected to high temperatures, low precipitation numbers in transmission and gear oils, and high demulsibility in oils for internal-combustion engines.

Most material specifications covering the kinds of fats or fatty acids to be used in greases are prime offenders against the enforceability rule. After a fat has been saponified and its soap mixed with lubricating oil, the separation of the fatty acids presents no great difficulty, but their identification to a degree of certainty which would warrant rejection of a product is almost impossible, and when mixtures of fats are used the problem is quite insoluble.

An extreme example of an unenforceable requirement was recently seen in some specifications for a steering-gear grease in which the oil was to consist of 80 per cent of cylinder stock and 20 per cent of other lubricating-oil having a pour-test of 25 deg. Fahr. How the purchaser proposed to separate these ingredients from each other was not disclosed.

Aside from the violations of the major principles of pertinence and enforceability, specifications frequently contain statements that reveal only slight acquaintance with elementary physics and chemistry and a disregard for the limitations of analysis. In many cases limits are set that are far beyond the reach of the most skilled analyst.

It is found that specification writers are totally ignorant of the nature of the materials they attempt to describe. There are many cases in which those skilled in inorganic analysis but unable to handle the more complex organic methods cause needless delays in arriving at the truth, advocate specifications which are impossible to meet, and fail, in testing their purchases, to protect their employers.

Mr. Ritchie's Paper

As the volatility of gasoline is the important factor in engine starting, it was determined to obtain information regarding the lean explosive limits, according to Mr. Ritchie's paper. Continuing he stated that the saturated vapor method gave large variations due to surface effects. The superheated vapor method used was applied to a 200 cc. glass bomb, varying the air fuel ratio to obtain the leanest mixture producing an explosion, with the fuel supplied at a definite rate. After adjustment to this ratio, tests were made on cracked gasolines.

Previously obtained results showed that the lean explosive limit for a mixture of hydrocarbon vapor and air at N.T.P. has been found to depend upon the size of the explosion vessel and upon the direction of flame propagation.

Data obtained from the tests indicate that a lean explosive limit of 25 to 1 air-fuel ratio applies to quiescent mixtures of air and vapors of such fuels when ignited at the center of a closed bomb of sufficient capacity, applying equally to cracked and straight run gasolines. It may be inferred from these results that aside from volatility there is probably no appreciable difference between the various kinds of hydrocarbon motor fuels as far as usefulness in starting an engine is concerned.

One of the major problems of the cooperative fuel research conducted at the Bureau of Standards for the past six months, according to Mr. Eisinger, has been a study of engine acceleration during the warming up period. The procedure consists in determining the change in engine speed every second, a chronometric tachometer indicating speed changes as small as $2\frac{1}{2}$ r.p.m. per second. A theoretical maximum speed time curve for the six cylinder $3\frac{1}{8}$ by $4\frac{1}{2}$ in. engine used in tests serve as a standard for comparison of test results.

The engine was mounted on a dynamometer provided with a flywheel whose inertia was equal to that of a 3400-lb. car. Tests were made to determine the influence on acceleration of various conditions. Types of carburetors, it was shown, had considerable influence, a plain tube carburetor showing up best.

THE paper by Mr. Spicer gave the results of a series of tests on the strength of splined shafts, made in an Olsen 60,000 in.-lb. torsion testing machine. About twenty specimens were ground to a fine finish all over; they included the short splines of the permanent fit type, the longer splines with the spline cut running out at both ends, large, plain round shafts with a diameter about midway between the large and small diameters of the splined shaft, and small round shafts of a diameter equal to the small diameter of the splined shafts. The large round size was included because it represents what is sometimes—on superficial consideration—regarded as equivalent in strength to the splined shaft.

All of the test specimens were from the same heat,

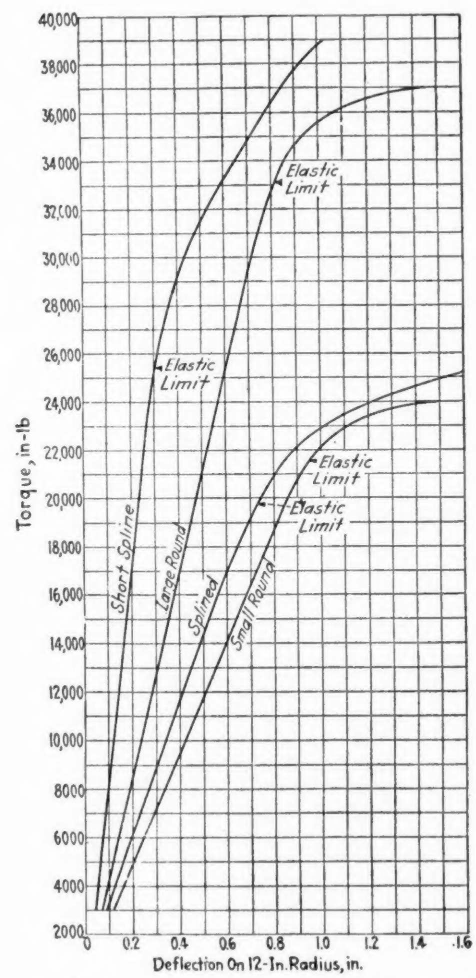


Fig 2. Results from the shafts when strained to just above the elastic limit.

and were specially selected by means of deep etching to insure uniformity and absence of defects. The analysis of the 1045 S. A. E. steel was as follows: C., 0.44; Mn., 0.63; S., 0.034; Ph., 0.017. The heat treatment used was as follows: Heat to 1625 deg. F. and cool in air; heat to

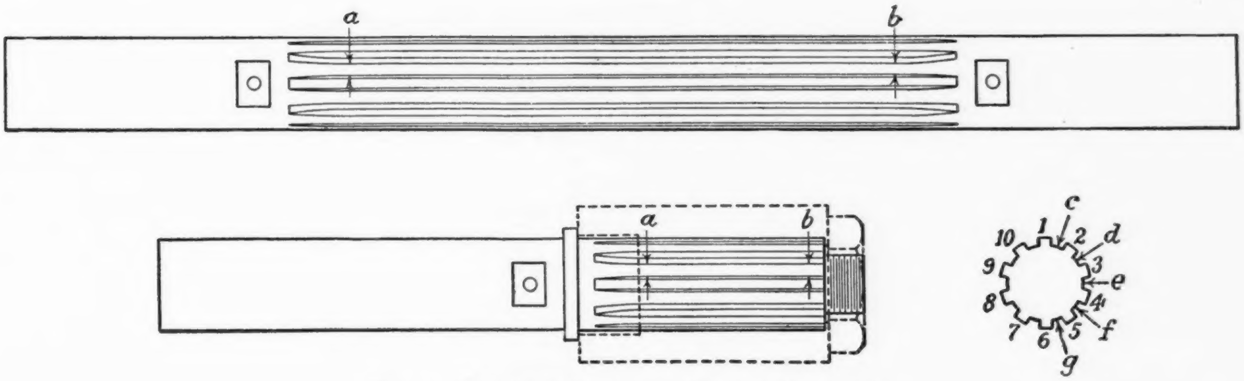


Fig. 1. Details of the two splined shafts tested.

1525 deg. F. and quench in water; draw at 1200 deg. F. for 30 minutes.

The results of the tests were shown in diagrams and curves. One thing brought out was that the Johnson elastic limit—the point at which the unit increment of deflection per unit of load increase is 50 per cent greater than at the beginning—is substantially less for a splined shaft than for a plain round shaft of a diameter equal to the base diameter of the spline.

When continuing the test to the breaking points, in the case of the short spline where the streses are more between three and four complete revolutions, while in the case of the short spline, where the streses are more localized, failure occurred suddenly after a much smaller angular distortion.

While the elastic limit was shown to be greater for the small round than for the splined shaft, the ultimate strength of the splined shaft was materially greater than that of the round shaft. Mr. Spicer expressed the opinion that the difference in ultimate strengths would be reduced if the shafts were made harder, so that the elastic limits approached more closely to the ultimate strengths.

The reason the elastic limit is smaller in the splined shaft is that the material in the splines adds very little to the torsional strength, but the strain on the fibers at the outside of the splines will be about the same as if the shaft were of solid round form and equal in diameter to the outside diameter of the splines. With fairly elastic material like that used in these tests, if the distortion is continued beyond the elastic limit, the splines assume a helical form and gradually come into tension, thereby adding to the resistance of the shaft to further deformation.

If the splines are supported, as in the case of the permanent fitting, so that they are in more nearly direct shear from the beginning of the load application, their shearing strength is added to that of the body of the shaft, thereby increasing the elastic limit very materially.

Engines—

Oil-Flow Through Bearings Proves Interesting Subject

THE engine session, held on Friday afternoon, might be regarded as a continuation of the Research Session which had concluded a few hours earlier, for both of the papers of the afternoon were essentially records of research work. H. L. Horning acted as chairman. Both of the papers of the session were joint efforts; that on "Oil-Flow Through Crankshaft and Connecting Rod Bearings," by S. W. Sparrow and Donald Brooks of the Studebaker Corp. of America, was read by Mr. Brooks, while that on "Valve Spring Surge," by W. T. Donkin and H. H. Clark of the Cleveland Wire Spring Co., was read by Mr. Donkin.

There was very little discussion on the valve spring surge paper, which was read first, although the "slowed-down" movies of spring action were much appreciated. They showed that at certain speeds the elements of the spring are subjected to a vibratory motion superimposed upon the forced motion due to the cam action, and of a very much higher frequency, so that although the motion of the bottom turn could be followed clearly by the eye, that of the central turns could not. At speeds between these critical speeds the motion of the whole spring could be clearly followed by the eye.

In replying to a number of questions, Mr. Donkin said that in overcoming trouble from valve spring surge it generally was necessary to redesign the spring so its static stress is greater. This reduces the maximum dynamic stress and thus protects the spring.

In discussing the Sparrow-Brooks paper, Chairman Horning said that in the days of splash lubrication he had had an argument with a member of his organization as to how the oil reached the surface of the crankpin bearing. The connecting rod head was provided with a quill which was supposed to pick up the oil and conduct it to the bearing surface. They found, however, that the bearing was oiled just as well if the quill was plugged up.

The subject of a drill hole in the connecting rod head

Left to right—Former president Harry L. Horning, president, Waukesha Motor Co., took the chair at the engine session. W. T. Donkin, engineer, Cleveland Wire Spring Co., read a paper on "Valve Spring Surge" which gained particular attention at the meeting; H. H. Clark collaborated in the preparation of the paper. Donald D. Brooks, research department, Studebaker Corp. of America, read the paper on "Oil Flow Through Crankshaft and Connecting Rod Bearings," which he prepared in collaboration with S. W. Sparrow of the same organization

in connection with force feed lubrication was brought up. E. S. Marks of the H. H. Franklin Mfg. Co., said they used this oil hole and had found it satisfactory as a means of increasing the oil supply to the cylinder walls. The hole was drilled through the top of the connecting rod head on the left side, viewed from the front (trailing side). Ralph Teetor of the Perfect Circle Piston Ring Co. mentioned that he had had some experience with an engine with connecting rods drilled in this way and had found that the loss of oil from the crankcase was no greater than when the holes were plugged up.

In answering an inquiry, Dr. C. H. Dickinson said the maximum pressure in the oil film of a bearing sometimes was as much as five times as great as the average pressure.

Oil Grooves in Bearings

The subject of oil grooves in bearings was taken up. S. W. Sparrow said the grooves took care of particles of dirt that might get into the bearings and tended to prevent cutting. On the other hand, it had been shown that they tended to break up the oil film.

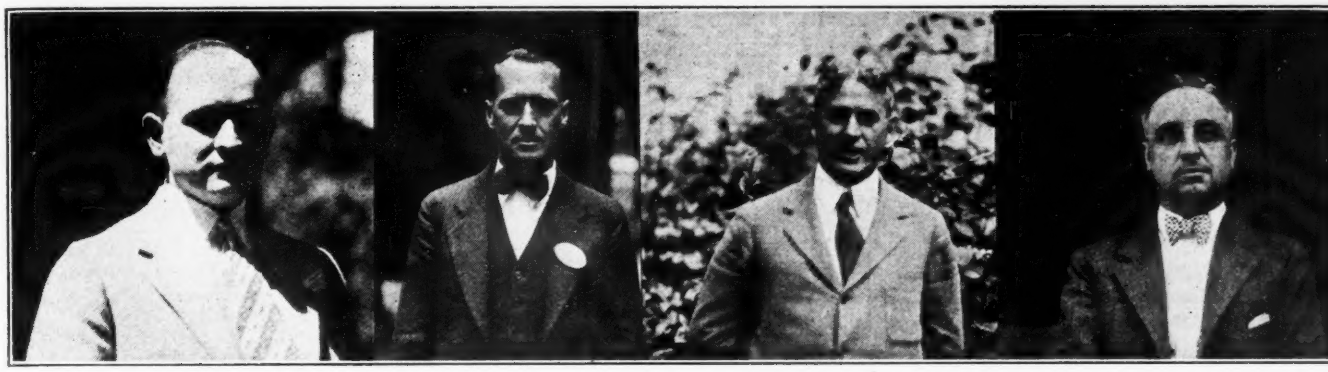
It was brought out in the discussion that oil pressures of from ½ to 100 lb. p. sq. in. can be successfully used, provided the clearances and the oil grooving are designed to suit the pressure. Dr. Dickinson mentioned a case where only four drops of fresh oil were fed per minute and the engine operated successfully. The case was also cited of Fageol buses operating in California. As originally built the engines were run for 70,000 miles without requiring the bearings to be tightened. Then air cleaners were added and the mileage was increased to 100,000; when oil filters were added the mileage between bearing adjustments was further increased to 140,000 miles. Contrary to some previous testimony to the effect that minute quantities of oil sometimes have given satisfactory lubrication, Mr. Horning advocated oil pumps of liberal size on pressure-lubricated engines; the number of outlets had been constantly increased and he did not consider it good practice to use the same size oil pump for engines of a wide range of outputs.

MESSRS. Brooks and Sparrow in their paper on "Oil-Flow Through Crankshaft and Connecting Rod Bearings," gave the results of measurements made to determine chiefly the effects of engine speed and oil pressure on the rate of flow. Their apparatus consisted of a tank constructed of 3 ft. of 4-in. pipe capped at each end and supplied with a gage glass, filling pipe, pressure-gage, and suitable valves and piping for controlling the pressure of the compressed air which served to force the oil through ¼-in. tubing to the engine under test. At the engine, a pressure-gage was attached to the feed-line to give the actual delivery pressure of the oil. When the oil-flow to a single bearing was being studied, the other bearings were fed in the normal manner, the oil-distributor pipe being blanked off to the bearing under test. When the flow to all bearings was being measured, the oil pump was disconnected and the bearings supplied directly from the metering tank.

The oiling system of the engine on which the tests were made is the usual pressure system, with direct pressure feed to all four main bearings. The connecting rod bearings are fed through the drilled crankshaft, holes in the main crankshaft journals registering with a circumferential groove in the main bearings for a portion of each revolution. No. 1 main bearing supplies oil also to the camshaft and timing chain as well as to No. 1 connecting rod bearing. Main bearings Nos. 2 and 3 each feed two connecting rod bearings, while No. 4 feeds only a single rod bearing.

The effect of changes in bearing clearance was also studied. The main bearing diametral clearance was increased from 0.005 in. to 0.010 in., the connecting-rod bearing diametral clearance from 0.003 in. to 0.0055 in. and the connecting rod bearing end clearance from 0.008 in. to 0.020 in.

Left to right—Paul M. Geyser, vice-president of production, Yellow Truck & Coach Mfg. Co.; William E. England, chief engineer, F. B. Stearns Co.; James M. Crawford, just resigned as chief engineer, Auburn Motor Car Co., who will assume another responsible engineering position in the near future; Harold E. Brunner, chief engineer, S K F Industries, Inc.; Ernest W. Seaholm, chief engineer, Cadillac Motor Car Co.



Left to right—Frederick K. Glynn, engineer, American Telephone & Telegraph Co., who was largely responsible for the Metropolitan Section stunt which gave all the members such a big thrill; Dr. B. J. Lemon, automotive contact engineer, U. S. Rubber Co.; David Beecroft, vice-president, Chilton Class Journal Co.; C. F. Gilchrist, chief engineer, Electric Auto-Lite Corp.

In this case, at least, the connecting rod and clearance had practically no effect on the oil flow. In this connection it must be remembered that the main bearing is subjected to the oil pressure continuously, while the connecting rod bearing is subjected to it for only a small fraction of the time; the latter, however, is subjected continuously to the pressure due to centrifugal force, which is high at high speeds.

MESSRS. Donkin and Clark in their paper on "Valve Spring Surge" pointed out that valve springs sometimes fail after comparatively short service. This abnormal failure nearly always occurs as a fracture in the region 1 to 1½ coils from the end. Microscopic examination of these fractures discloses them to be fatigue failures. The fracture usually makes an angle of 30 deg. with the axis of the wire and, as a rule, numerous secondary or "incipient" fatigue cracks, making the same angle with the axis, appear in the vicinity of the fracture. It is obvious that stress of a higher order than that calculated by the static formulas exist in the neighborhood of the fractures.

To provide a convenient way to study valve-spring surge on various types of valve gear, a machine capable of reproducing the valve-gear motion described was built. This consists of a shaft and flywheel driven by an induction motor through a variable-speed transmission. The outboard bearing of the shaft is mounted in a cast-iron head upon which is mounted a block containing the valve-gear parts assembled in their correct relation to one another. The cam used to actuate the gear is mounted on the extrme end of the shaft. Speed variation is obtained by means of a handwheel placed at the front of the machine and connected to the transmission at the rear. A speed indicator, graduated from 500 to 2500 r.p.m. is geared to the camshaft. Such an assembly comprises a unit that can be adapted to almost any type of poppet-valve mechanism.

The action of the springs was studied by means of the Vibroscope, a stroboscopic device comprising a neon lamp, and a super-speed motion picture machine. It was found that surge in valve springs is the result of proportionality between the natural frequency of the spring and the frequency of impulses given to it by the camshaft. The impulse given the spring by the cam action tends to set up in the spring a wave motion, adjacent coils approaching and receding from each other in quick succession, the phase of the cycle at any instant varying along the coil. If the frequency of free vibration of the spring is a direct multiple of the frequency of impulses imparted to the spring by the cam, then there will be spring surge, unless the cam impulses are so widely spaced (low engine speed) that the free vibrations are dampened out between successive impulses.

Ricardo has given the following formula for the natural frequency of a spring, viz:

$$n = 531\ (R/W)\ \text{cycles per minute}$$

where R is the "rate" of the spring in lb. p. in. and W, the weight of the active mass of the spring in lb. This formula is based on the assumption that the spring vibrates with it's ends fixed, each half being alternately extended and compressed.

Owing to inaccuracies in the gage of the wire, the pitch and the number of active coils, two springs made according to the same design seldom have exactly the same natural frequency, and the above formula gives only approximate results.

From the above it may be inferred that springs should be so designed as to have a very high natural frequency, so that the vibrations set up by one cam impulse may have practically died out before another impulse is received. The way in which the results of the research can be utilized in spring design was illustrated in the paper by an actual example, dimensions and characteristics being given of a spring that gave a great deal of trouble from early fatigue failure, as well as of a spring that was designed to take the place of the former and prevent such failures. These data are given in the following table:

Item	Original Spring	Redesigned Spring
Mean or pitch diameter, in.	1.102	0.878
Free length	3 1/32	2 23/32
Total number of coils	10½	9
Gage of wire, W. & M. No.	9	10½
Load, with valve open at 2 1/32 in., lb.	48	53
Load, with valve closed at 2 11/32 in. lb.	29	29
Stress, with valve open, lb. per sq. in.	41,200	57,000
Stress, with valve closed, lb. per sq. in.	25,300	31,200
Stress range, lb. per sq. in.	15,900	25,800
Rate, lb. per in.	59.0	77.3
Weight of the active mass, lb.	0.1435	0.0700
Frequency, free vibrations per min.	10,750	17,600

It will be seen from the formula for the frequency of vibrations given above that this frequency increases with the rate of the spring and inversely as the weight of the spring. The rate of the spring cannot be altered materially, hence the object must be accomplished by reducing the weight of the spring, which involves an increase in the stresses under static load. It will be noticed that a finer gage was used, and the pitch and number of coils were decreased.

The two springs were studied by means of the apparatus previously described. It was found that the original spring had a surge period at as low a camshaft speed as 560 r.p.m., while the lowest speed at which there was noticeable surge with the new spring was 1330 r.p.m. Excessive surge may cause the valve to remain open, or it may cause the engine to hum unpleasantly. In any case, it increases the maximum stress and the stress range, which results in a decrease in the life of the spring. The maximum stress may be raised by surge to that imposed upon the material when the coils of the spring are closed up by static load, and even beyond, due to the impact stresses. For instance, in the case of the original spring discussed above, the stresses were as follows:

Spring compressed solid, 69,000 lb. p. sq. in.

With valve open, 42,200 lb. p. sq. in.

With valve closed, 25,300 lb. p. sq. in.

When this spring is surging violently the coils which are closed will be stressed to 69,000 lb. p. sq. in., while the coils at the opposite end will be opened up to a certain degree. This might possibly relieve these coils entirely, in which case there would be a stress range of 69,000 lb. p. sq. in. It is well to remember that this stress range is passed through at an exceedingly high rate depending on the free vibration frequency—in 0.00558 sec. in this particular case. Spring surge therefore may be said to have three effects, namely:

1. Increase in maximum stress.
2. Increase of the stress range in the end coils.
3. Very high frequency of stress fluctuation.

The conclusion was drawn from the research that surge cannot be entirely eliminated, as the tendency to vibrate is an inherent characteristic of a spring. To eliminate fatigue failure of valve springs due to surge, the springs should be designed to have a very high frequency of free vibration, in which case noticeable surge will occur only at speeds beyond those at which the engine normally operates.

Body Design—
Attractive Lines Best Obtained by "Hands-Off" Policy

WITH the papers at the body session confined to his own, Amos Northup of the Murray Body Corp., had Clayton Hill read his paper on "Body Designing" and devoted his time to making a pastel color sketch of a four-door sedan in front of an interested audience, the sketch emphasizing such features of design as the paper covered. W. R. Strickland presided in place of R. S. Begg, who was unable to be present.

Good taste and artistic ability, according to Mr. Northup's paper, are too often confused, although they do not necessarily bear a close relation to each other. He said in part:

"Much of the lack of unity and beauty in automobile design of the past can be attributed to the unfortunate interference in body designing activities by executives not qualified by experience, training or talents to dictate the form a given body should take. They do not realize that there is a wide gap between the possession of good taste and real artistic ability. The two are easily confused. Now frequently we hear executives comment with enthusiasm on this or that design at the Automobile Salon. They express criticism of their own designers at the factory because they do not seem competent to produce equally attractive designs. Most, if not all of them, fail to realize that the custom body designer is 'King of his realm.'

"From the laying down of the small scale sketch to the completion of the sample body, his word is law. It is no wonder that his bodies possess a unity of outline and appearance. Every detail reflects his personal judgment. To each he applies artistic taste unhampered by the criticisms and suggestions of others unqualified to collaborate with him. The result can never be a patchwork quilt or unrelated ideas.

"Experience seems to demonstrate that the most attractive motor car bodies are the product of experienced designers working without interference from well-meaning executives who hope to assist with their criticisms. Greater accomplishment would seem to be promised by the entire responsibility for appearance on men whose training, talents and temperament are along artistic lines.

"Let me emphasize the importance of allowing a competent body designer to assume the entire responsibility for the outline or form of all those exterior units of the chassis which must of necessity be in harmony with the body design. In no other way can a complete car be designed as a harmonious unit. In this classification should be listed the fenders, radiator, bonnet, splashers, running boards, lamps and such smaller appurtenances as filler caps, lamp tie rods and the like. Too frequently we see attractive bodies suffering detraction from ugly radiators, cumbersome lamps or crudely designed accessories."

Left to right—William R. Strickland, assistant chief engineer, Cadillac Motor Car Co., was nominated as first vice-president of the S.A.E. for the year 1928. He presided at the body session. A. E. Northup, body designer, Murray Body Corp., prepared the paper on "Body Designing" which L. C. Hill read before the body session

Photographic Sidelights at French Lick Springs

Left—L. C. Hill, Murray Body Corp., was caught by the photographer on his way in. He is chairman of the Meetings Committee

Charles E. Heywood, manager, Meetings and Sections Department, S.A.E., was the busiest man at the meeting

Above—J. P. Nikonow (right), Amtorg Trading Corp., won the tennis singles championship. E. L. Burke (left) played Nikonow in the semi-finals

Photos by Lazarnick

Right—A close-up of the patron saint of French Lick Springs—Tom Taggart

Below—Nathan Lazarnick, who photographed the meeting for Automotive Industries, and Sidney R. Dresser, chief cable engineer, Whitney Blake Co., discuss the weather, or what have you, just before the train pulls out

Below—H. L. Zimmerman and the Reo "Flying Cloud" coupe which he took home with him as a result of the Metropolitan Section stunt

Field sports aroused plenty of enthusiasm. Below is the finish of the three-legged race

Just Among Ourselves at

OLD Jupe Pluvius was the most important and most active guest at the meeting this year. The old boy wasn't invited but he came around for a while every day, casually gumming up the procession wherever he could and finally being instrumental in causing a washout which turned back the 5:45 p.m. special train which started to carry conventionites back to New York, Philadelphia, Cleveland, Detroit and Indianapolis.

* * *

TWO farmer boys were responsible for seeing the washout and signaling the engineer to stop, thus avoiding possibly a serious accident at least to those in the first car of which ye editor was one. A purse was taken up for the youngsters after the train had been sent back to French Lick. Despite the beginning of another blinding rainstorm, the washout was filled in and the final start made about midnight. Even then, Old Jupe was on the job to bid *auf weidesein* to the engineers as he had been to welcome them and break up their first day's sports on Wednesday afternoon. On this first occasion he introduced a special feature in the form of a hailstorm in which the hailstones were estimated by golfers at all sizes between that of a golf ball and the dome of St. Paul's Cathedral.

* * *

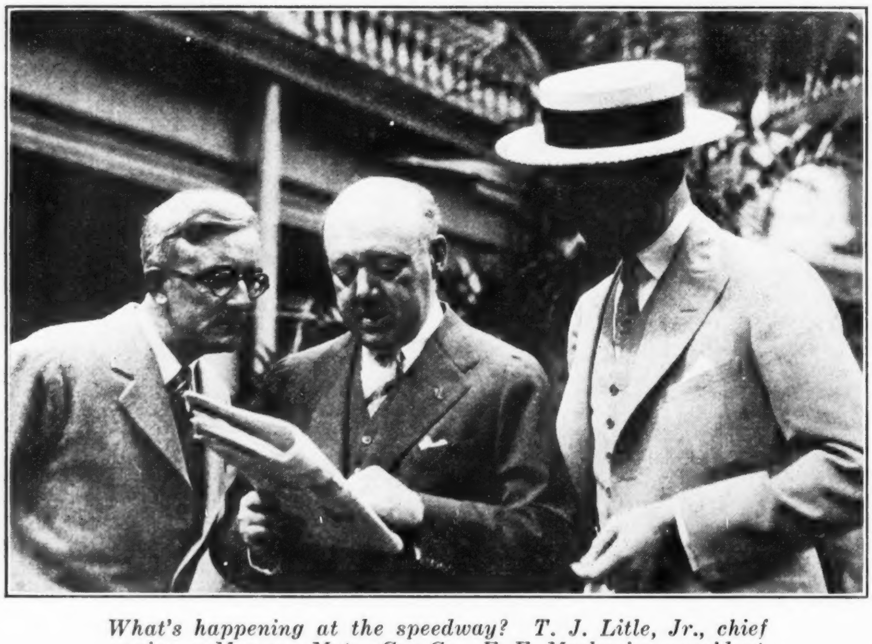
FOR once those rated as theorists beat the so-called practical men at their own game when the Washington Section team won the Chevrolet chassis assembly contest. The team from the nation's capital was composed largely of Bureau of Standards men, including Dr. H. C. Dickinson, chief of the division of Heat and Power of the Bureau. John O. Eisinger was captain of the team, which included also W. H. Ragsdale and H. H. Allen. True the team was completed by one or two outsiders—D. B. Brooks of Studebaker, G. A. Burn of Tidewater Oil, Dalton Risley, Jr., of Craveroiler and D. P. Barnard of Standard Oil of Indiana—but some other sections had to complete their teams from outside talent as well, so the winners both deserve and get full credit. Their time was 10 minutes 22 seconds.

* * *

THE tennis tournament was completed only by dint of the most strenuous effort on the part of the committee headed by B. J. Lemon of U. S. Rubber. When the regular clay courts were flooded by the rains, a temporary grass court was rigged up on the lawn and permitted play during one whole day which otherwise would have been lost.

* * *

T. J. LITLE, JR., chief engineer of Marmon, flew to the meeting from Indianapolis in a plane which the Marmon Company has for regular use of officials. He arrived for breakfast Wednesday morning, but was unable to land because of the golf courses having been flooded by the rains of the previous night. He turned back to Louisville's excellent landing field, however, got into a Marmon car and reached French Lick in time for the luncheon meeting on stock car racing.



What's happening at the speedway? T. J. Litle, Jr., chief engineer, Marmon Motor Car Co.; F. E. Moskovics, president, Stutz Motor Car Co. of America, and Capt. E. V. Rickenbacker, chairman, Contest Board, American Automobile Association, looked eagerly to see what the qualifying times were for the Indianapolis race. All three took a prominent part in the conference of car engineers held during the convention to discuss stock car racing

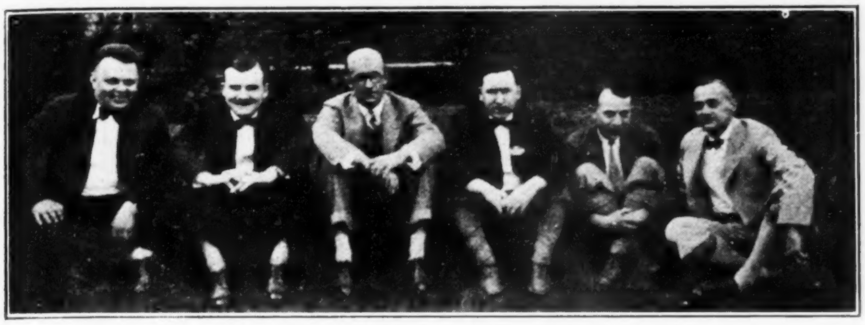
* * *

GOLFERS were appreciative of the wooden tees presented by the Morse Chain Co. and of pencils given by the Bakelite Corp. Both were in constant use throughout the meeting, although it is rumored that most of the pencils were used more prolifically for writing down golf scores than for making technical notes. All of the teeing up wasn't done on the golf course, either.

* * *

CONSIDERING the time it took an ex-president of the S.A.E. to properly adjust a couple of headlights during an experiment at the headlight session, it's hardly any wonder that a good many laymen have thrown up their hands in despair when trying to do the same job with only an instruction book to guide them. Whatever future practice may be, the single adjustment crowd seemed to have the best of it at this particular session.

the S. A. E. Summer Meeting



Editorial staff of the Daily SAE

WHILE there might be a little difficulty in picking out the high spots of the meeting, we sure saw most of the low spots while watching the club wielders perform on the hill course. Even there, however, close observation revealed so many that determination of which was the lowest would be no easy task.

* * *

WHERE'S the next summer meeting going to be held? Lots of people were asking that question on the train coming back. Nothing definite has been decided, but Quebec seems to be among the leading possibilities at the present time, with Spring Lake and White Sulphur still in the running in the minds of some. Heard something about Montauk Point, but couldn't find any information indicating that site as a real possibility for 1928.

* * *

DETROIT Section stunt this year consisted of the opening of the "Club High Hat" in a baggage car at 11:59 p.m. Thursday night. The club provided the best of night club entertainment with the bad features —bills and dinner checks—omitted. We can't report on the finish of the party, but our scouts report that it did finish, although no one knows exactly when.

* * *

DELCO-REMY Corp. was responsible for the *Daily SAE* this year, O. Lee Harrison being editor-in-chief and E. V. Rippingille, assistant. Under the managing editorship of Bill Moffet, the publication performed an almost impossible feat; it surpassed the efforts of last year. The accompanying photograph provides a record of the only minute during the meeting when the members of the staff were at rest.

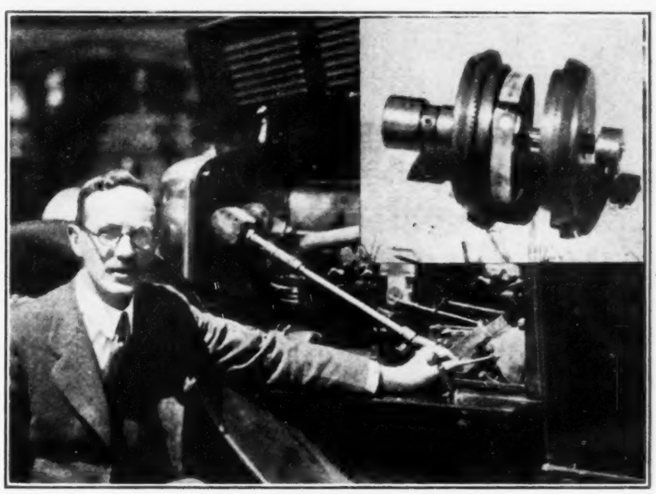
* * *

POWER steering system applied to a car was demonstrated by Mr. Nieman of the Bethlehem Steel Co. A shaft with universal joints in it extends alongside the engine from the timing gear at the front to the steering gear near the rear end of the engine. The shaft runs continuously as long as the engine is running, but it ordinarily idles. By means of the steering hand wheel a double clutch is controlled whereby the steering driveshaft is placed in driving relation with the steering mechanism. The driver therefore needs to supply only the amount of energy required to engage the clutch, the energy required for moving the steering wheels over one way or the other being furnished by the engine. With the car standing at the curb and the engine idling, a man standing outside the car could easily move the wheels over with one hand. We expect to publish a full description of this device in an early issue of *Automotive Industries.*

* * *

C. F. AND J. T. RAUEN of Dayton, Ohio, demonstrated an engine compression brake and an automotive sprague. For the compression brake they claim that it gives approximately as good braking in high gear as is ordinarily obtained in low gear, with the added feature that no fuel is sucked into the cylinders while braking. This also holds true while coasting. The automotive sprague prevents any undesired downhill movement of the car till the engine takes hold. In other words, the car is started up hill the same as on the level. Another feature of the sprague is that it is a back-fire or kick-back preventer.

With the use of the powerful compression brake, almost any hill can be descended without using the mechanical brakes, and at the same time the engine does not turn over at excessive speeds. Both devices are quite simple and cheap to manufacture.



C. W. Nieman, of the Bethlehem Steel Corp., and his steering gear amplifier

Passenger Cars—

Experimental Work in Light-Weight Design Explained

Paper by P. B. Jackson describes development carried on by Laurence H. Pomeroy. Aluminum parts exhibited.

THREE papers had been scheduled for the Passenger Car Session on Saturday afternoon, but when, about 30 minutes after the official opening time, hardly any but members of the S. A. E. staff and of the press had congregated in Convention Hall, it was decided to read the papers by title only and adjourn. A special train at 5:45 p. m. had been arranged for, to enable members to attend this session without staying over until the next day, and many took advantage of this to prolong their stay at the resort until Saturday evening, but since this was the first day without rain, the call of the outdoors evidently was too strong.

P. B. Jackson of the Aluminum Co. of America, had prepared a paper on "An Experimental Development in Light-Weight Design." In the first part of this paper Mr. Jackson discussed the relation of weight to performance in motor cars. In the second part the fundamental engineering principles of a material that has very different mechanical properties, as compared with steel, were outlined.

Exhibition of Car Parts

In connection with the presentation of the paper an exhibition was made in the lobby of the hotel of a collection of parts of a car developed for the Aluminum Co. of America by Laurence H. Pomeroy, now chief engineer of the Association Daimler Co. of London. The car has a 133 in. wheelbase and is equipped with a six-cylinder $3\frac{1}{4}$ x 5 in. engine. The weight of the car ready for the road is 2985 lb. No weight reduction from the usual construction is claimed for the body, which is made entirely of cast aluminum.

Among the parts of the engine made of aluminum are the cylinder block, the cylinder head, pistons, connecting rods, crankcase, water pump and oil pump. Cast-iron cylinder liners are inserted after the block has been raised to 450-500 deg. Fahr., while valve seats of aluminum bronze, of a composition developed by the Air Service for air-cooled aircraft engines, are inserted in the mold for the casting. An incidental advantage of the aluminum block is said to be that exhaust valves keep cool much better and ordinary carbon steel valves can be used. Complete with electrical equipment, manifold and carburetor, the engine weighs 452 lb. or 6 lb. per hp.

The chassis frame is made of aluminum, as are the front and rear axles. A Borg & Beck clutch is used, and by substituting aluminum alloy for ferrous metals a saving in weight of 7 lb. was made.

The front axle center is an aluminum alloy forging and weighs 21 lb., which represents a saving of slightly over 50 per cent. All steering connections (links and levers) are of aluminum. Aluminum brake shoes are used, while the brake drums are incorporated in the aluminum wheels, and provided with cast iron liners pressed in. Liberal ribbing of the wheel and drum assures rigidity and freedom from squeaking, while the high heat conductivity of the metal tends to keep down the temperature of the brake surfaces. The front axle complete with wheels and brake drums weighs 130 lb., while the rear axle, which has its housing, gear carrier and wheels made of aluminum, weighs only 369 lb. This includes the torque tube and propeller shaft. These low weights of unsprung parts should give the car excellent riding qualities.

In concluding his paper, Mr. Jackson paid a tribute to Mr. Pomeroy, who upon coming to this country in 1919 joined the Aluminum Co. of America to develop the use of aluminum in automobile manufacture. After having designed a small four-cylinder car of which four were built, he started on the present six-cylinder model. The first of these has been driven 200,000 miles. The results of all the experimental work, Mr. Jackson said, were such as to reflect great credit upon him.

Left—Frank H. Martin, Stewart-Warner Speedometer Corp.; C. E. Salisbury, director of service, Hupp Motor Car Corp., and C. B. Wisenburg. Right—Talking it over just before teeing off

Plea for Use of Better Electrical Apparatus

A PAPER prepared by D. P. Cartwright of the North East Electric Co., for presentation at the Passenger Car Session, contained a plea to car manufacturers for the use of better electrical apparatus. "Failure of the electrical apparatus should not account for 53 per cent of the emergency calls," Mr. Cartwright said. "Better apparatus can be produced by the electrical equipment manufacturers, but the cost will be greater; on the other hand the cost to the owner, including maintenance and emergency service costs, will be less."

Mr. Cartwright's paper contained a large amount of data on reasons for emergency calls compiled by automobile clubs that furnish an emergency service. All electrical failures may be divided into five classes according to their primary causes, as follows:

1. Failure after a reasonable mileage operation.
2. Failure due to maintenance neglect.
3. Vehicle manufacturers' refusal to purchase electrical apparatus with the necessary stamina, of sufficient capacity and to properly install such equipment.
4. Failure due to faulty design, material or workmanship.
5. Failures due to climatic conditions.

Maintenance neglect failures are due to several causes. A lack of lubrication usually develops generator or ignition unit bearing trouble on the road. The battery is, however, the unit in the electrical system that requires the most attention and is so frequently neglected. When water is not added the plates sulphate and then there are no lights for the drive home. Corrosion is permitted to form an insulating film on the battery posts and the car won't start because the current cannot penetrate this film to get to the starting motor and the ignition coil. The charging rate is not increased in the winter to compensate for the longer hours the lights are used and the heavier duty the starting motor is called upon to perform.

Another Cause of Battery Trouble

Again the result is a call for a rental battery. Another reason for rental battery calls is the discharge of the battery through the ignition coil when the switch is not turned off. Quite a percentage of failures due to these causes result in emergency service trips to the owner's garage rather than to the roadside.

Formed terminals to which the wires are soldered have replaced connections that were formerly made by looping the wires around binding posts or screws. These terminals are securely fastened with nuts and lockwashers and road failures due to loose connections have been greatly reduced. A well made wiring harness is now being used and the network of wires that used to be productive of puzzling short-circuits and grounds has disappeared.

Offsetting these improvements is the tendency to install generators and batteries of insufficient capacity. The car in the $800 class requires practically the same current supply and battery capacity that the car in the $5,000 class does. Each has the same lamp load, the ignition current is the same and the current consumed by the starting motor is nearly equal, since the larger engine is, or should be, equipped with a more efficient unit.

A 6-volt generator with a normal capacity of 10 amp. is soon set up to 15 amp. if it can be made to produce that. The overload heats the unit beyond

Upper left—The ladies shot a mean arrow. Lower left—Waiting for cars to the golf course. Upper right—A large crowd watched the field sports. Lower right—There was lots of action in the chassis assembly contest

the maximum permissible temperature and a breakdown results. The battery that is too small overheats and disintegrates. Because of insufficient capacity it is quickly discharged and trouble follows. To aggravate this lack of capacity there is an increasing tendency to add current-consuming cigar lighters, stop and spot lights, electric windshield wipers and gasoline gages, etc. The owner of the car that is equipped with a generator that cannot be set up to 15 amp. for winter requirements does not have many roadside failures from this cause until he decides to get a car with ample generator and battery capacity.

Data secured from two automobile clubs show that the average monthly percentage of emergency calls due to electrical failure in 1926 was 53, the lowest being 47 and the highest 59.5 per cent. Batteries failures varied from an average of 20 per cent in May, June, July and August to 32 per cent in December, the increase evidently being due to the heavier demands on the battery in winter service. Starting failures averaged 13 per cent during summer and 15.5 per cent during winter months. This, however, is a rather difficult cause to analyze, and all of the troubles cannot be ascribed to the electrical units; a cold engine and carburetor troubles bear the responsibility for a portion of them.

Five thousand emergency calls answered by the R. A. C. of Great Britain were analyzed and showed electrical failures to be responsible for 28.6 per cent, ignition failures alone being responsible for 21 per

cent. Failures of the starting system accounted for 5.5 per cent and failures of the lighting system for 2.1 per cent. In comparing these figures with similar ones of American origin it must be remembered that ignition on most of the cars in use in Great Britain is by magneto. This better showing of the electrical equipment on cars in use in Great Britain should cause our manufacturers to reflect. The author pointed out, however, that one explanation for fewer battery and starter failures in England might be found in the fact that one British car is being delivered with a tag warning the owner not to use the starter in winter.

IN the paper prepared by Messrs. Fenner and Horine on how legislation affects motor vehicle design, most emphasis was placed upon trucks and the general conclusion of the authors seemed to be that restrictive legislation in many states seriously limits the most effective use of truck transportation through the use of large capacity vehicles.

Passenger cars have not been subjected to many restrictions by legislative and regulatory bodies, the chief item being in relation to lighting requirements. Buses have already met with rather severe design restrictions in many places but the total number of such vehicles is relatively unimportant in the motor vehicle population of the country. Also, there are a number of signs which the authors believe indicate that as the use of buses increases restrictions will be lowered or, at least, be based upon a more thorough study of operating requirements than has been the case in the past.

Truck development has suffered because of the severe weight restrictions placed upon them for the ostensible purpose of protecting the public highways. These restrictions are usually based upon the gross weight of the load or upon wheel or axle load. In this connection it was pointed out that a number of investigations made by various agencies have proved that static weight alone has no harmful effect upon properly constructed roads but that impact reaction is the destructive factor and this depends, in general, upon wheel load, truck speed, tire equipment and road roughness.

The prevalence of gross load restrictions has frequently caused overloading of vehicles of small capacities, which is likely to prove much more harmful to highways than were the same load carried in a vehicle of larger capacity.

The main objection offered to the present legislative tendency was that it compels uneconomic transportation without gaining anything thereby. It was pointed out that weight limitations have no effect upon the total tonnage hauled over the highways but make it necessary to employ more vehicles for the job at a greater total cost. This tendency toward weight restrictions has slowed up the development of large capacity trucks, it is believed, although for many jobs trucks of 5-ton or more capacity are the most economical type which can be used and, when properly designed, have little more harmful effect upon roads than smaller vehicles.

All Reports of Standards Divisions Accepted

AT the meeting of the Standards Committee on Tuesday afternoon, under the chairmanship of Charles M. Manly, all reports of Divisions were accepted, most of them without discussion.

In discussing the first report presented, by the Electrical Equipment Division and covering a 7 mm. distributor nipple, C. S. Crawford observed that a nipple of the dimensions specified could not be used on 16-point distributors, as used by his and one other automobile company and also by airplane engine manufacturers. He suggested that the bead at the bottom of the nipple, which prevents it from being thus used, be eliminated. It was objected that this would necessitate making the nipple of much better rubber than otherwise would be necessary, and for this reason, and also because it was realized that the proposed nipple would meet a very large proportion of automotive requirements, the suggestion was withdrawn. Another point raised—that without tolerances on the internal diameters, the nipple might not give tight joints—was met by making the specified dimensions of these diameters maxima. With this one amendment the proposed design was adopted.

The Motor Coach Division proposed the following definition of the term "turning radius," which definition was concurred in by the Motor Truck and Passenger Car Divisions by almost unanimous votes:

"The turning radius of an automotive vehicle is the radius of the arc described by the center of the track made by the outside front wheel of the vehicle when making its shortest turn." The definition received the approval of the committee.

Some animated discussion was aroused by the proposal of the Pails and Fittings Division to lower the standard height of front and rear bumpers two inches to take account of the general lowering of passenger car frames. The discussion indicated that considerable damage is caused by non-adherence to the S.A.E. bumper height standards. On the other hand it was brought out that to be most effective, bumpers must be on a level with the frame bars, while another factor effecting bumper height is that of appearance. Considerable emphasis was laid by some speakers on the fact that bumpers are protective devices and not ornaments, but it was held out against this argument that if a bumper mounting in accordance with the proposed specification would detract in any way from the appearance of a car, the specification would not be adhered to. W. J. Saffold, who said he had only recently made a complete survey of bumper heights on current models, moved that front bumpers should be 20 in. high (instead of 18 in. as recommended by the Division), but the amendment was defeated. The report was finally adopted as made, with a proposal from W. R. Strickland that it be transmitted to the Executive Committee with a full record of the discussion.

As a conclusion of the session Chairman Manly gave an account of moves made to establish an organization for international standardization. In America we now have the American Engineering Standards Committee which, while not doing any standardization work itself, correlates the work of different standardizing bodies. There are similar national organizations in other countries, and the secretaries of these organizations have held a number of meetings, at one of which the proposal was made to form an international standards organization. The question immediately arose whether this body should do standardizing work itself or simply set its stamp of approval on such work done by national bodies.

Souders Makes *97.45 M.P.H.* to Win *500-Mile* Race in Duesenberg

George Souders

Dirt-track driver in 91½ cu. in. car nearly equals record made by DePaolo with 122 cu. in. Duesenberg in 1925.

By Sam Shelton

STAMINA to stay in a race replete with dramatic and spectacular incidents brought victory to George Souders in a Duesenberg Special at the fifteenth annual 500-mile Decoration Day automobile race at Indianapolis this year.

Coming to the front from what looked like a poor start, and surviving drivers and mounts of greater experience and flashier speed, the youthful Hoosier with nothing much but a dirt track reputation to recommend him finished the 500 miles in 5 hours, 7 minutes, 33.8 seconds at an average speed of 97.45 m.p.h.

Thus the first full 500-mile race of the 91½ cu. in. cars under the jurisdiction of the Contest Board of the American Automobile Association established a record on the brick oval at Indianapolis comparing favorably with the 101.13 m.p.h. for the same distance established May 30, 1925, by a 122 cu. in. Duesenberg driven by Pete DePaolo.

In the Memorial Day race last year the 91½ in. cars were used for the first time, but because of rain the race was called at 400 miles when Frank Lockhart in his Miller Special was declared the winner with an average of 95.88 m.p.h.

In this year's race dramatic incidents came one after another, combining thrills and spectacular demonstration with tragedy in a way that no doubt affected the drivers and had something to do with slowing the pace down from the peak of around 105 m.p.h. that was being registered in the early laps by the leaders.

The first spectacular incident, which brought injury to a courageous driver and thrilled the 150,000 spectators with admiration, was the burning of Norman Batten's Miller Special, No. 8.

Coming down the straightaway in front of the grandstands at better than 100 m.p.h., the gasoline tank caught fire and flames trailed for 10 or 15 feet behind the roaring vehicle. Recognizing his predicament, Batten made every effort to bring his car under control while the blaze enveloped the whole rear end of the vehicle and all but surrounded the driver's seat. Past the press pagoda the car whirled with its speed still too great for the driver to jump with safety and too dangerous a thing to be turned loose on a

First Ten Drivers and How They Finished at Indianapolis

The first 10 drivers who finished this year's 500-mile race, their cars, time and average miles per hour, are as follows:

	Car	Driver	Time	Av.
1.	Duesenberg Special	George Souders	5:07:33.08	97.45
2.	Miller Special	Earl Devore	5:19:35.95	93.86
3.	Miller Special	Tony Gulotta	5:22:05.08	93.14
4.	Jynx Special	Wilbur Shaw	5:22:12.05	93.11
5.	Duesenberg Special	Dave Evans	5:30:27.11	90.78
6.	Per. Cir. Duesenberg Spec.	*Peter DePaolo	5:31:49.34	90.41
7.	Miller Special	Eddie Hearne	5:33:05.74	90.06
8.	Boyle Valve Special	†Ralph Hepburn	5:52:36.21	85.65
9.	Miller Special	Cliff Bergere	6:15:20.07	79.93
10.	Junior Eight Special	Frank Elliott	6:23:25.69	78.24

*** Finished Bob McDonogh's car.**

† Finished Tommy Milton's car.

In addition to these, Fred Frane, in a Miller Special, and Jimmy Hill, in a Nickel Plate Special, were running at the finish.

track where 32 other daring drivers were racing.

Holding the steering wheel with one hand, Batten was standing upright in the cockpit to escape in what-

FRED DUESENBERG, noted designer of racing cars, who developed the sturdy little 91½ cu. in. machine which carried Souders to victory in this year's 500-mile grind at Indianapolis. This is the third time that a car of Duesenberg's design has carried off first honors in this event. It was a Duesenberg Special that finished in front in 1924, and again in 1925 a Duesenberg was first. Incidentally, an all-time record was established in 1925

ever degree he could the heat of the raging flames. Not until he neared the south end of the pits did the car slow down enough for the driver to jump, and then as he sprawled to the ground the blaze shot many feet into the air in full view of all in the grandstands.

Although he suffered burns on his back and hands and was taken to the hospital, Batten was not seriously injured.

A little later, as a group of bunched cars approached the south turn, Henry Kohlert, driving his Miller Special, No. 23, rode high upon the bank and tangled wheels with car No. 25, driven by Cliff Bergere. Kohlert's car turned over and rolled down the bank, leaving the driver lying in the middle of the track. Kohlert was carried off the track and to the hospital, suffering from serious injuries. Car No. 25 continued in the race. This accident occurred in front of one of the grandstands.

When in its twenty-fourth lap, car No. 18, a front-drive Cooper Special, driven by Jules Ellingboe, hit the wall on the north turn and was wrecked and the driver was seriously injured.

Although there were other instances of failure of cars at critical times, not until near the finish was the height of the dramatic reached.

After battling gamely against odds, the two Duesenbergs, No. 32 and No. 24, had attained first and second places respectively. With a three-lap lead over No. 24, No. 32 had just been given the checkered flag announcing it had finished when No. 24 started its 198th lap, apparently certain of second place, being four laps ahead of its nearest competitor.

But as it came around to finish the lap, with Babe Stapp at the wheel, it was slowing down. The pit crew urged Stapp to continue, but he could not. His rear axle drive gear was broken and the second prize was snatched from his hands, with only two laps to go.

From the start of the race at 10 a. m. to the finish of the winner at 7 minutes and some seconds past 3 o'clock, there was a succession of surprises and disappointments, leaders dropped out and cars that had not been reckoned with took leading positions. Drivers with national reputations found themselves unhorsed and mere youngsters from the dirt tracks sprang into the limelight.

Frank Lockhart, the young star and surprise of a year ago, who has since proved his mettle on other tracks, was the undisputed leader for 81 laps until he had to stop to refuel. Although he lost the lead, he soon regained it and held it until his 119th lap, when his car, a Miller Special No. 2, went out with a broken connecting rod. He won $10,900 of lap prizes, the award being $100 for the winner of each of the 200 laps.

Charles Bauman, another dirt track youngster, who took the lead when Lockhart made his pit stop, held it for 10 laps, winning $1,000 in prize money, but after his 91st lap he met misfortune, breaking a pinion gear in the rear axle. Bauman was driving a Miller Special.

The next car to bask in the temporary glory of a prospective winner was the Cooper Special No. 14, started by Bob McDonogh, and later wheeled by Pete DePaolo, whose own Miller had dropped out in its 31st lap. McDonogh had kept his car well up in the front rank and when Lockhart went out he was in second place ready to grab the lead. DePaolo relieved him as driver and held the car in front for 30 laps, winning $3,000 in lap prize money. Then at about 350 miles the engine in No. 14 began acting erratically, spitting and coughing. It lost speed and never regained its stride. It kept pegging along and was able to finish in the money by reason of the good start that it had.

It was after No. 14 slowed down that George Souder's Duesenberg forged to the front and soon gained its invincible lead. This car made no stop until 400 miles, and then, with a safe margin over its companion Duesenberg, which was No. 24, Souders wisely brought it into the pit for gasoline, oil, water and a change of tires.

Thus refreshed it took the track again with little delay and ran beautifully until it brought home the first prize of $20,000.

There started in the race 33 cars in 11 rows of three each. Positions were determined according to time made in the qualifying trials. Frank Lockhart had the pole position in the first row, having qualified at 120.1 m.p.h. for 10 miles.

All of the cars starting qualified at better than 100 m.p.h. and some which qualified at better than 90 were not permitted to start because of the number being limited to 33.

The pacemaker for the start was a LaSalle roadster with T. E. Myers, General Manager of the speedway, as passenger, and Willard Rader as driver.

Preceding the start an official car of the A.A.A., carrying Val Haresnape, secretary of the Contest Board, E. V. Rickenbacker, chairman of the Contest Board, and C. F. Kettering, referee, had circled the track.

As the pacemaker brought the cars down the stretch at more than 100 m.p.h. and as nearly as possible in their starting positions, the official starter, George Townsend, president of the Moto Meter Co., waved the red flag that signaled the beginning of the race.

Leon Duray in his front-drive Miller leaped out in front, but when the cars came around to the grandstand stretch, Lockhart was well in the lead and there he remained for 81 laps.

The cars in the order in which they lined up for the start and their drivers, were:

Car	Driver	Car	Driver
Perf. Cir. Miller Spec.	Lockhart	Miller Special	Bauman
Perf. Cir. Miller Fr. Dr.	DePaolo	Miller Special	Hearne
Miller Spec. Fr. Dr.	Duray	Jynx Special	Shaw
Erskine Miller Spec. Fr. Dr.		Miller Special	Melcher
	Hartz	Cooper Spec. Fr. Dr.	Ellingboe
Boyle Valve Spec.	Hepburn	Duesenberg Spec.	Souders
Boyle Valve Spec.	Woodbury	Miller Special	Schneider
Cooper Spec. Fr. Dr.	McDonogh	Duesenberg Spec.	Stapp
Miller Spec. Fr. Dr.	Lewis	Detroit Spec. Fr. Dr.	Milton
Cooper Spec. Fr. Dr.	Hill	Th'ps'n V've Duesenberg	Morton
Miller Special	Batten	Miller Special	Gulotta
Boyle Valve Spec.	Petticord	Duesenberg Spec.	Evans
Cooper Spec. Fr. Dr.	Kreis	Miller Special	Cotey
Junior 8 Spec. Fr. Dr.	Elliott	Elgin P't'n Pin Spec.	Leckleider
Miller Special	Bergere	Nickel Plate Special	Hill
Miller Special	Devore	Perf. Cir. Duesenb'g	Shoaff
Miller Special	Shattuck	Miller Special	Frane

Superchargers and Timing Gears Cause Most Failures

High average speed during first part of Indianapolis race and bumpy condition of track responsible for large number of mechanical troubles this year.

By Paul Dumas

THE very high average speed of the leader during the first 200 miles, combined with the bumpy condition of the track, was responsible for the abnormally large number of mechanical troubles encountered by the 33 cars which started in this year's Indianapolis Race.

The very things that have produced the speed ability of the 91½ cu. in. cars were the greatest offenders.

Of the 21 cars that were eliminated, four were put out of commission due to definite failure of the supercharger drive mechanism. Two other cars, Schneider's Miller and Hartz's Erskine-Miller, were forced out due to broken timing gears and broken crankshaft key respectively, and it is probable that, in at least one of these two cases, the supercharger drive assembly was indirectly responsible.

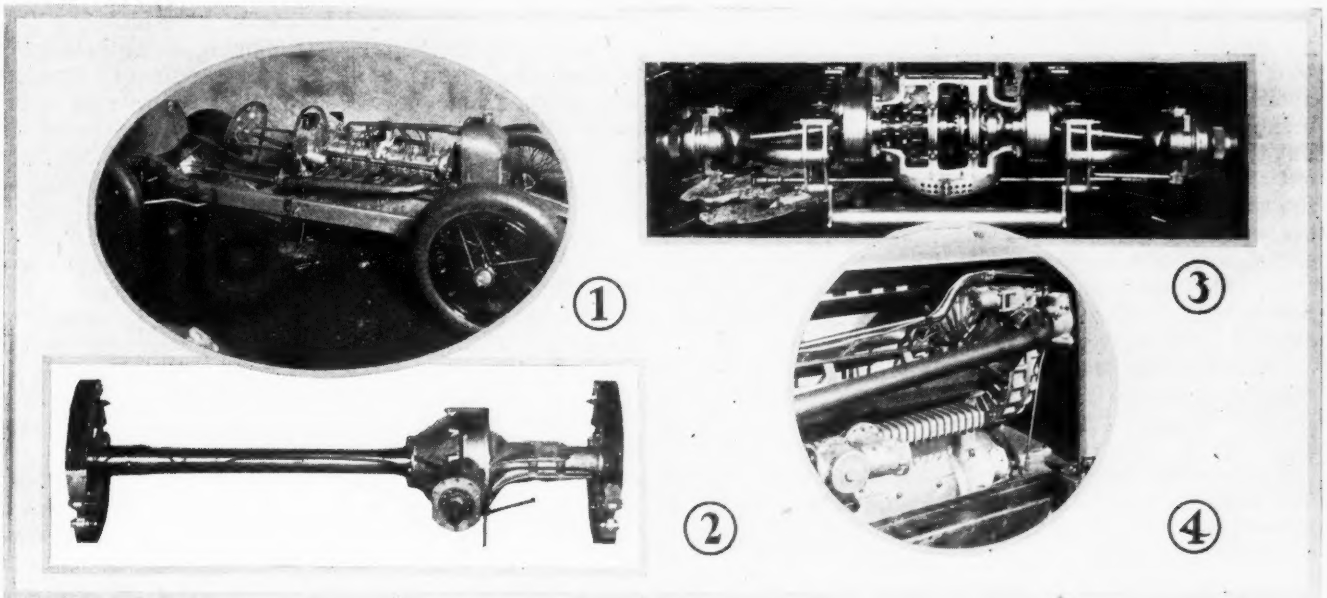
Next to supercharger and timing gear troubles, which took toll of five cars, came failure of the rear axle and driveshaft parts. Four cars were eliminated due to failure at these points, one of them being the No. 24 Perfect Circle Duesenberg, which was forced out with broken axle drive gears when five miles from the finish in second position. The Miller Special driven by Bauman was forced out on account of similar trouble at a time when he was leading.

The condition of the track played a large part in sending three cars permanently to the pits with leaking gasoline tanks. Two of these cars, Batten's Miller and Duray's Miller, were set afire from this cause.

Lockhart led until eliminated at the 300-mile mark by a broken connecting rod. This and Shattuck's broken valve were the only mechanical failures attributable to the engine proper.

Aside from frequent replacement of plugs, there was no ignition trouble. It is apparent that chassis parts, especially those of front axle and power transmitting mechanism, need greater factors of safety to withstand high speeds on tracks of this type.

More thorough study of the problem of a reliable



1. One of the new offset Duesenberg cars. Note that the front end of the engine is close to the right side rail and that the differential is at the left of the axle. This permits a lower position for the driver. 2. The rear axle from one of the offset Duesenbergs. The pinion and ring gear are specially made to accommodate the angle of the pinion shaft. The left axle tube is integral with the left side of the differential case and is made of Lynite. 3. Duray's front drive Miller, showing internal parts. Note the novel pivot pin and knuckle constructions and the universals. 4. Two-stage General Electric blower operating in conjunction with inverted type carburetors. Notice the pressure relief valve on the blower casing

supercharger drive able to withstand frequent decelerations is also imperative. In the past there have been some failures of the supercharger impeller but the recent use of ribbed and heavier casings of bronze instead of aluminum has almost entirely eliminated trouble at this point. The new casings and impellers have made possible outputs as high as 28 lb. absolute.

Cars finishing in the money and not troubled with blower failure in most cases were fitted with balanced step-up assemblies having gears of wider face than last year. The lack of rigidity of the rear system under the heavy strain of cornering at high speed may prompt the use of radius rods between rear axle housings and frame, or equivalent measures, just as it will bring more serious study of the causes of failure as exhibited by the broken front axle on the No. 9 Cooper Special and failure of front axle spring pad on Lewis' Miller front drive.

Not Built for Rough Track

It was apparent that many of the contesting cars, although adequate for satisfactory performance on board tracks, do not have sufficient vibration—withstanding ability to permit of long sustained high speed on a track of this nature, where mere speed does not decide the winner.

Of the 33 cars starting, 21 were eliminated due either to driving accidents or mechanical troubles. There were a total of 110 pit stops and the unusual number of 49 reliefs were made, these 49 being confined to 18 cars. A considerable number of pit stops were devoted to supercharger testing and to the tightening of loose engine and chassis parts.

That the fast pace set by the leader was too much for the cars is evident in the fact that 10 were eliminated before the 100-mile mark had been passed.

Observed at rest in their garages, the 1927 models of 91½ cu. in. racing cars are essentially duplicates of the 1926 models, and the impression remains even after a hasty glance under their hoods. But observe them in action with the stop watch, and the chances are that you will ask who inserted the dynamite, and where. For the 1927 racing cars of 91½ cu. in. displacement represent the fastest pieces of machinery that ever performed on the brick-surfaced Indianapolis Speedway. The results of last year's development work are not immediately apparent to the eye, but they are evidenced by the performance and stand out on close examination. And it is likely that when the story of the 1927 race is told over the drafting boards, there will be much talk about how the inverted carburetor, the high-pressure blower and new inlet manifolds made possible such engines. These, together with the lowered centers of gravity and speeds as high as 7800 r. p. m., attained even with the rear-driven cars, have been the outstanding speed-increasing developments of the year.

All American-Built

There were approximately 36 cars that constituted the real field at Indianapolis, and these are all American-built and of the eight-cylinder in-line type. Of these 36 cars, the offset-type Duesenbergs (Perfect-Circle, Duesenberg and Thompson-Valve Specials) are the only outstanding new chassis creations. These new jobs, which are characterized by an extremely low center of gravity, compare favorably with the front drive jobs in the matter of over-all height and are decidedly lower than any of the other rear wheel drive cars. It was with one of these cars that Souders won the race.

As will be seen in the accompanying illustrations, the unusually low construction is attained by placing the front end of the engine at approximately the right front corner formed by the frame side rails and cross member rectangle and carrying the power drive line aft towards the diagonal corner of the frame to the differential located adjacent to the left rear wheel. With this arrangement of the units, the axis of the engine crankshaft and propeller shaft forms a diagonal of the frame rectangle. This layout of itself does not permit of any noticeable lowering of the car, but it does allow of placing the driver's seat alongside the propeller shaft, instead of over it, with the result that the "from the hips down" portion of the drivers body is well below the top of the frame side rails. To further enhance the cornering ability of the vehicle the entire frame assembly is offset on the axles, the former being 2½ in. closer to the wheels on the left side.

Although the engine of the diagonal offset Duesenbergs is substantially the same as last year, some few changes have been made in the cylinder blocks, mainly in the relative positions of the angularly mounted valves. The total angle between inlet and exhaust valve stems has been increased so as to prevent pocketing in the combustion chamber. The contour of the inlet passages also has been altered slightly and these two changes, in combination with improvements made in the supercharger, have brought about an increase in crankshaft speed of 700 r. p. m. The piston pin retaining method has been changed from a thin wide ring encompassing the piston skirt to a system of inserted soft metal plugs in the piston pin ends.

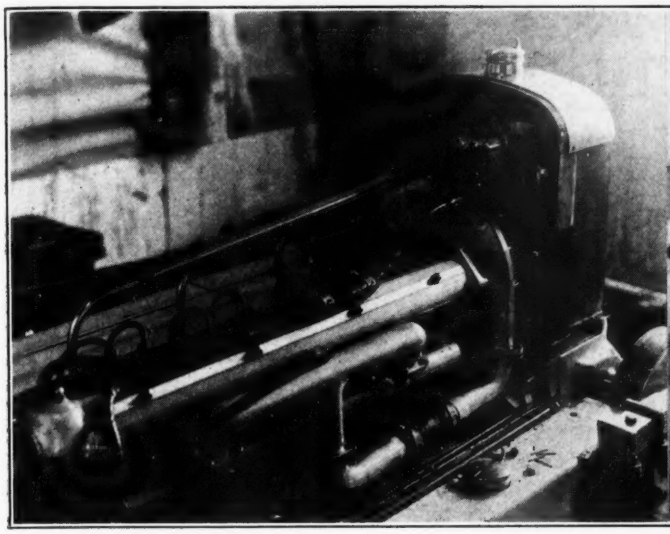
Crankshaft is Lighter

The crankshaft is slightly lighter than last year. The main bearing journal diameter has been reduced from 2 to 1⅝ in. To accommodate the angular drive line the engine bell housing legs have been changed, that on the right being considerably longer than the left one, but with these exceptions the engines are duplicates of those used last year. No changes have been made in the clutch or transmission, and the same is true of the double-drop, double side rail type of duralumin frame, except that the cross members have been altered to take the gas tank which forms the tail of the new bodies. Rubber shock-insulated mountings are used for the front and rear springs on both of the new jobs.

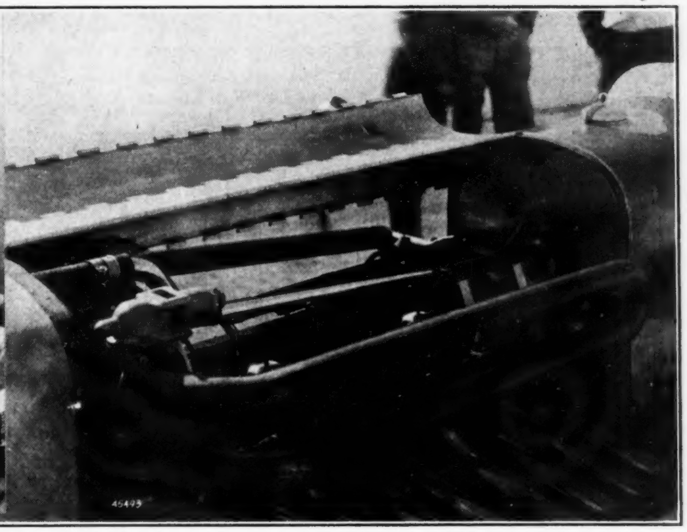
Propulsion and torque reaction are taken by a torque tube, as formerly, but the front spherical mounting is now adjustable by means of a split casting which bolts to the rear face of the transmission housing. The single universal joint carried within the bulbed front end of the torque tube is now of the ball type and made by the Universal Products Co.

External details of the three-quarter-floating rear axle assembly are visible in the accompanying illustration. The long right hand tube is machined from a chrome-nickel forging which is flared at its inner end to engage the recessed face of the Lynite differential housing. Through-bolts pass through the differential housing and serve to tie it on one side to the right hand steel tube and on the other to the cast Lynite left hand tube of the assembly. It will be noted that the pinion shaft enters the axle at an angle and to compensate for this the pinion and ring gear are cut on a pitch line of corresponding angle.

The other Duesenbergs, driven by Evans, Corum and Hauser, are 1926 models with slight changes in



Rear view of Duray's front drive Miller showing inverted carburetor, which is the outstanding development this year on all cars of every make



Exhaust side of the Detroit Special, showing portion of the piping to the two-stage General Electric blower

the design of the supercharger and inlet manifold.

The Cooper Specials were revised Miller front drive cars reconstructed under the direction of Earl Cooper who has incorporated several features of his own. The main components of the Miller engine have been retained and externally the clutch, rear and front axles appear unchanged.

The revision made on the original Miller design, as announced by Cooper, include a supercharger of greater output and inlet manifolds designed to give better volumetric efficiency by reducing the temperature of the mixture. Dimensions of engine parts have not been changed, but there has been a change in material specifications in several cases. The pistons are diecast Bohnalite and crankshafts, connecting rods, and camshafts are made from material supplied by the Central Alloy Steel Co.

Changes have been made in the clutch, which is now of the multiple-disk type, incorporating five driven disks. Front wheel drive layout changes include the substitution of Weiss metallic uniform-velocity-type joints in the front wheel drive shafts and the use of a special Ruckstell semi-planetary two-speed gearset in place of the regular Miller sliding gear assembly.

Revisions in the braking system include the use of four-wheel Bendix internal brakes, mechanically operated. The rear wheel brakes are connected to the brake pedal while the fronts, which function as the emergency brakes, are connected to the lever. Front spring suspension is the same as originally built by Miller, but the steering has been changed by substituting a Gemmer-Marles cam-type gear. These cars are provided with bodies designed by Cooper and his corps of drivers, Hill, McDonogh and Kries. Cockpits are very comfortably cushioned, and support for the driver's neck is provided by an extension on the seat bulkhead which forms a stream-lined head rest.

The Detroit Special to which Cliff Durant was assigned as driver, is built around a Miller front-drive chassis. Like the Cooper Specials, it was built, prepared, and tuned behind closed doors, under the supervision of men of very wide experience. It is rumored that the car was built in Detroit in accordance with joint designs of Tom Milton, twice winner of the Indianapolis race, and Dr. Moss, supercharger expert of the General Electric Co.

The supercharger, of the centrifugal type, is driven from the front end of the crankshaft through a train of spur gears. Instead of having a single eight-cylinder magneto operating at crankshaft speed, this engine is fitted with two modified eight-cylinder Robert Bosch magnetos, each supplying four cylinders and operating at camshaft speed. The front drive transmission and differential unit are said to be of a unique design, permitting a change of drive ratio gears in less than half an hour. Some changes have been made in the original Miller valve action, although the conventional tappet cup elements are retained. The gasoline and oil tanks incorporate changes suggested by Milton, and the body has been altered to meet his ideas of comfort. It is said that more than $29,000 was expended in the construction and reconstruction of this car, which may be campaigned in European events this summer.

Lockhart an "Engineer"

Perhaps the most thorough and workmanlike job of revising a rear wheel drive type Miller car is seen in the Perfect Circle Miller driven by Frank Lockhart. Although classed as a young race-car chauffeur with a penchant for heavy footwear, Lockhart would find no difficulty in qualifying as an experimental engineer. By a process of research that would do credit to a manufacturing organization, he has improved the original supercharger which, it is stated, develops 28 lb. of pressure. He has built and is using a portable type supercharger testing dynamometer and carries with him to each track such testing instruments as thermocouples, pyrometer and pressure indicator. Among the accomplishments credited to him are revisions in the original connecting rod and valve keeper construction which have increased the reliability of performance of these parts.

Of the remaining cars, practically all were Miller products, even though raced under a variety of different names. These include the Elgin Piston Pin Special, Jynx Special, Jones Whitaker Special, Elcar Special, Burt Special, Nickel Plate Special and Boyle Valve Special. Three of the last named cars were entered as a team captained by Cliff Woodbury of dirt track fame. These cars, as is well known, are stock Miller creations except that the engines are equipped with flat seat laminated head valves of Boyle make.

AUTOMOTIVE NEWS SECTION INDUSTRIES
Philadelphia, Pennsylvania
Saturday, June 4, 1927

Factories Scale Outputs; Weather Cuts May Sales

PHILADELPHIA, June 4—Production of motor cars is being generally curtailed this month, although a few of the factories are maintaining output rates established earlier. The second quarter showing, despite the slowing down that is expected at this time of the year, should be very good for most companies. Large production schedules in the first months of the quarter will counterbalance largely such revisions made.

Announcement of the forthcoming new Ford light car is likely to cause a somewhat retarding effect on the sales of cars in the lower priced brackets but the industry generally is pleased that the announcement was made at a period when sales have a seasonally declining tendency. The effect of the announcement unquestionably will be most exerted in the case of Ford's own product.

Totals of car and truck output in May will about equal those in April, according to advance estimates, the truck market again showing up more favorably than the passenger car in comparison with 1926 business. Considerable rejuvenation is noted in the truck industry as result of the sustained good business, many of the smaller companies becoming much more active and some important new companies being formed.

Stocks of new and used cars in dealers' hands generally are normal and the adjustment in manufacturer shipping schedules in June should bring them to a very satisfactory level by the end of the month.

(Continued on page 884)

Ford Reports Indicate High Compression Head

NEW YORK, June 1—Latest advices on the new Ford model, which will make its appearance later in the year, generally confirm previously published statements in AUTOMOTIVE INDUSTRIES. It is understood the car will have new engine head, giving high compression; three speeds forward gear shift; slightly lengthened wheelbase and new body lines. Price will be approximately the same as Model T.

Plans Storage at L. I.

NEW YORK, June 1—The Long Island City plant acquired by Ford Motor Co. from Durant Motors, Inc., will be used as a warehouse for new Ford cars, it was learned here today. Only one floor will be required for storage purposes, however, and plans for utilization of the remainder of the plant are unknown.

Continental Starts Record Schedules

DETROIT, June 1—Continental Motors Corp. has scheduled 29,965 engines in June, against 19,413 in June last year, a gain of 54 per cent. The June schedule is the greatest in Continental's history and follows a gain of 37.2 per cent in May and 34 per cent in April.

Continental has added more than 50 new customers in the industrial field giving it 265 steady customers in this steadily growing branch of the business.

"I feel more hopeful for the future of our business than ever, despite the opinion that has been fostered by bankers and others that the day of the parts maker is over," said W. R. Angell, executive vice-president, in issuing the following statement today:

"We are very much gratified over the business done the last few months. Our shipments greatly exceeded those of the same period last year, and the schedules we have received from our customers for shipments during the next few months indicate further substantial increases. We expect that June will be the biggest month the company has ever had. In preparing for this increased business, substantial machinery moves were required and the get-ready expense charged against current business necessarily reduced the net profits for the first six months of our fiscal year ending April 30. The net earnings for April and May, however, will more than take care of the half year's dividend requirements."

T. F. Merseles is Chosen Johns-Manville President

NEW YORK, June 2—Theodore F. Merseles, president of Montgomery, Ward & Co., has been named president of the Johns-Manville Corp. and will take office July 1. H. E. Manville, now president, will become chairman of the board at that time.

Mr. Merseles, George Whitney and Francis D. Bartow, the latter members of the firm of J. P. Morgan Co., have been elected directors of the Johns-Manville company.

N.A.C.C. Estimates May Output 342,082

NEW YORK, May 31—Continuation of a remarkably high production rate by National Automobile Chamber of Commerce members is indicated by the preliminary estimate of May shipments, which gives a total for the month of 342,082 against 342,819 in April. May, 1926, shipments were 289,571 so there was an 18 per cent gain last month over the corresponding period a year ago.

For five months of 1927 the members shipped 1,454,673 vehicles, a gain of 138,780 units or 10.5 per cent over the corresponding period of 1926.

A.E.A. Appoints Goldman Shop Equipment Director

CHICAGO, June 2—Martin E. Goldman, formerly sales manager of the General Equipment Corp., has been selected to head the shop equipment division of the Greater Market Development Bureau of the Automotive Equipment Association. Mr. Goldman has been active in A. E. A. work for a number of years and this year was made chairman of the association's shop equipment committee. He also is a member of the shop equipment committee of the Motor & Accessory Manufacturers Association.

Chevrolet to Add Units

DETROIT, June 1—The Chevrolet Motor Co. will make improvements to its main plant in Flint costing approximately $2,000,000. A new main office will be of brick and concrete, three stories high and 260 x 60 ft. A parts building, three stories high and 530 x 122 ft. will also be built. When these two new units are completed the present office and parts buildings will be dismantled to make way for a new manufacturing unit. According to Charles F. Barth, vice-president in charge of manufacture, who made the announcements, Chevrolet's production continues to run at 4500 cars a day.

H. F. Krueger, Pioneer, Dies

MILWAUKEE, June 1—Harry F. Krueger, said to have originated the idea of putting steering gears on the left side of automobiles, died here this week. Mr. Krueger built a car called the Eclipse in 1903 which had left-hand drive and is believed to have been the first so equipped.

Speedwagon Line Extended by Reo

Now Includes Capacities From 1000 to 6000 Pounds and 114 to 175-in. Wheelbases

LANSING, June 1—Reo Motor Car Co. has announced a complete new line of speedwagons which are designed to meet transportation requirements of every business. The new line includes capacities to handle loads ranging from 1000 lb. to 6000 lb., and has wheelbases ranging from 114 in. to 175 in.

The first model introduced is on a 133-in. wheelbase with chassis rated at one and one-half ton and equipped with four-wheel brakes. Two body styles are available on this master speedwagon—a nine-foot stake body which with closed cab is priced at $1,620, and cab with express body is priced at $1,580.

Prices also have been announced on the 114-in. wheelbase speedwagon junior—the de luxe parcel delivery panel body being $1,085. The chassis of the speedwagon junior is priced at $895. Additional models completing the new line will be announced within a short time.

Sharp Rubber Price Cut Seen Within Coming Year

WASHINGTON, June 2—Radical changes in the price of crude rubber as delivered in the United States, with best indications that it will take a sharp drop, reaching the economic price levels that must ultimately prevail, are expected within the next year, according to information in the hands of the rubber division of the U. S. Department of Commerce.

The maximum price necessary to enable well managed plantations to earn 15 per cent dividends is 32 cents a pound, the division has learned. British-controlled plantations now are reporting forward contracts at an average price of 61 cents a pound for delivery this year.

German Company Absorbed

BERLIN, May 21 (*by mail*)—The Dux Automobile Werke A.G. of Leipzig-Wahren, that for some time past have been in financial difficulties have now passed over into the possession of the Prestowerke A.G. in Chemnitz. The Dux factory will be carried on henceforth under the name of the new owner. The Prestowerke is an old concern founded in 1906 for the making of bicycles and automotive products. The motor vehicles, comprising passenger cars, delivery cars and ambulances, have a good reputation. The company employs about 2200 men.

Walter R. Green

CHICAGO, May 28—In the death of Walter R. Green, May 12, the automotive industry lost one of its pioneer accessory manufacturers. Mr. Green was president and general manager of the International Stamping Co. of Chicago, which he founded in 1894. He introduced steel mud guards for bicycles and motorcycles and later entered into the manufacture of various automotive accessories. He was active in trade association work.

N.A.C.C. Withholds Used Car Opinion

NEW YORK, June 2—The Windsor used car plan was discussed for several hours at the members' meeting of the National Automobile Chamber of Commerce today. No vote or action was taken on the subject, the manufacturers as a group expressing no opinion.

All directors whose terms expired at this time were reelected and at a later directors' meeting, all the officers, headed by Roy D. Chapin, president, were reelected. The directors returned were A. J. Brosseau, A. R. Erskine, Alvan Macauley, W. E. Metzger and R. E. Olds.

The members voted to join with the Society of Automotive Engineers and the Bureau of Standards in a program of research to develop the best type of headlight for motor vehicles. An appropriation was made for awards in the national safety essay contest sponsored by the chamber.

Favorable presentations of the Windsor plan were made by Floyd Allen of General Motors Corp. and others. C. A. Vane, general manager of the National Automobile Dealers Association, said he did not feel in position to express either approval or disapproval. He did say—stressing a point frequently brought out in the discussion—"no one plan could be considered a panacea for the used car. Other important questions were overproduction of cars, especially certain models, and frequent model changes."

N. A. C. C. Truck Members Meet

NEW YORK, June 1—Truck members of the National Automobile Chamber of Commerce at a meeting this week heard F. J. Scarr, of the Scarr Transportation Service, Inc., discuss possibilities of widening the field of use for commercial vehicles. Cooperative plans of New York and Chicago truck dealers were outlined by Harry Bragg, general manager of the Automotive Merchants' Association, and Charles M. Upham, business director of the American Road Builders' Association, went over the arrangements for the 1928 good roads show in Cleveland.

Hercules Builds New Six

CANTON, OHIO, June 1—Hercules Motors Corp. has introduced a new series of six-cylinder engines designed particularly for motor buses and trucks. The company reports substantial increases in business in the first quarter.

Business in Brief

Written exclusively for* AUTOMOTIVE INDUSTRIES *by the Guaranty Trust Co.

NEW YORK, June 2—Unfavorable weather continues to be a major factor, both in business movements and in agricultural work. Corn planting is extremely late, and the condition of winter wheat has deteriorated. An offsetting influence is the advance in prices of farm commodities in the last few weeks. Commodity prices in general remained virtually stationary last week, while stock prices continued to rise in an exceedingly active market. A somewhat firmer tone developed in money rates.

FREIGHT CAR LOADINGS

The movement of railway freight continued in large volume during the week ended May 14, and was approximately equal to that of a year ago. Car loadings numbered 1,029,126, as against 1,024,416 in the preceding week and 1,029,748 in the corresponding period last year. Loadings for the year to date total 19,309,366 cars, which compares with 18,799,955 cars loaded a year earlier.

BANK DEBITS

Bank debits to individual accounts reported to the Federal Reserve Board for the week ended May 25 were 3.8 per cent below the total for the preceding week but 13.7 per cent above that for the corresponding period in 1926.

FISHER'S INDEX

Professor Fisher's index of wholesale commodity prices stood at 139.9 last week, as against 140 a week earlier and 139.6 four weeks earlier.

FEDERAL RESERVE STATEMENT

Bills and securities held by the Federal Reserve banks increased $33,900,000 during the week ended May 25. Discounts declined $29,600,000, with decreases of $20,500,000 in discounts secured by government obligations and $9,100,000 in other bills discounted while open market purchases increased $10,700,000 and holdings of government securities $52,900,000. Note circulation decreased $5,600,000, deposits $27,800,000 and reserves $45,300,000. The reserve ratio declined from 79.3 to 78.8 per cent.

The call loan rate continued to range between 4 and 4½ per cent last week. Rates on time loans were slightly higher at 4¾ to 4½ per cent, as against 4¼ to 4½ per cent a week earlier; while commercial paper rates were virtually unchanged at 4 to 4½ per cent.

Hudson and C. I. T. Sign

NEW YORK, June 2—An agreement was signed this week between Hudson Motor Car Co., and Commercial Investment Trust Corp. for the future handling of retail time-payment sales.

Kansas City Dealers Launch Move to Junk 12,000 Cars

Organize Subsidiary Wrecking Company to Operate on Large Scale Basis and Get Maximum Prices for Scrap Metal and Reduce Scrapping Costs

KANSAS CITY, May 31—A bold stroke at solving the greatest problem of the automobile business—used car handling, has been taken by the Kansas City Motor Car Dealers Association, with a "side-swipe" at another evil—the junk dealer, thrown in. The "stroke" is the organization of a company owned by the dealers, with a cash capital of $50,000 for the purpose of wrecking many of the used cars now in service in Kansas City and vicinity. The dealers estimate there are 12,000 cars now on the streets which should be junked.

The company, incorporated under the name of the United Auto Wrecking Co., will be in full operation in June. A lease has been taken on a tract of land with building and switching tracks already for use. Modern wrecking machinery will be installed and it is expected that an average of two and three car loads of junk from wrecked motor cars will be shipped daily, at least for a time. There will be no attempt at salvaging parts but the cars will be wrecked and sold as junk.

Instal Wrecking Equipment

The plan, according to George A. Bond, secretary of the dealers' association and originator of the plan, never has been attempted in any city in the United States. The nearest thing to it, according to Mr. Bond, is the cooperative wrecking organization in Omaha.

"In our study of the situation before starting our own company we found the dealers in Kansas City were supporting 41 auto wrecking companies, or junk dealers," Mr. Bond said. "These junk dealers are receiving 85 per cent of all the cars they handle from the motor car dealers, the dealers selling the cars with the understanding they would be wrecked and all parts sold as junk. However, we found 40 per cent of the cars were being patched up with temporary repairs and put back into use—thereby clogging the channel of the legitimate used car business of the dealers.

"Our survey also showed us there now are in operation in Kansas City more than 12,000 motor cars that should be in the junk pile. It is our purpose with the new wrecking company, to put these cars where they belong, just as fast as possible."

The wrecking company will not confine its business to members of the dealer organization, but will purchase junk cars from dealers in the surrounding territory who desire to sell.

Get Old Cars Off Street

"Our object is to get old cars out of use and thereby open up new avenues of business," Mr. Bond said. "Dealers will be paid cash for cars. We believe we will be able to pay more than the average junk man would for the reason we will be doing business on a big scale and able to get the top price for the junk shipped. Some junk dealers now are selling to larger concerns for $3 a ton, whereas the larger company gets much higher prices."

New Stoughton Company to Resume Manufacture

MILWAUKEE, May 28—The Stoughton Co. is the name of a new Wisconsin corporation which has been organized to take over and continue the business of the Stoughton Wagon Co. The reorganization has been effected with the cooperation of creditors. Assets valued at $320,000 are transferred to the new corporation.

Directors of the Stoughton company are: Theodore M. Dahl, secretary, White Motor Co., Cleveland; Price M. Davis, president, Shadbolt & Boyd Co., Milwaukee; F. J. Vea, Stoughton, president of the old company; C. F. Martins, vice-president, State Bank of Madison, Wis.; Emerson Ela, attorney, Madison.

The new company will issue $100,000 of first mortgage and $300,000 of second mortgage bonds, which covers the purchase price of the assets of the old concern and provides working capital. Operations will be concentrated on the Stoughton line of trucks and buses and quantity output of commercial bodies for trucks.

Canadian Merger Forms Hayes Wheel & Forgings

CHATHAM, ONT., May 31—A consolidation of the Hayes Wheel Co., of Canada, Ltd., and the Canadian Hardwood Co., Ltd., has taken place under the name of Hayes Wheels & Forgings, Ltd. The Hayes company had factories at Chatham and Merriton, Ont., and the Canadian Hardwood company had several plants located in various parts of Ontario. The new company, it is stated in the prospectus, will be the largest manufacturers of automobile wheels in Canada. The company's property at Chatham covers an area of 7 acres, while at Merriton it holds on a long term lease renewable in perpetuity, a valuable waterpower of a capacity of 1050 hp. of which 750 hp. has been developed.

The capitalization consists of a bond issue of $1,500,000, of which $600,000 will be outstanding; $1,500,000 of 7 per cent preferred stock, of which $650,000 will be outstanding, and 100,000 shares of no par value common stock, of which 50,000 shares will be outstanding. Hon. J. D. Chaplin will be president of the company and William Kistier will be manager.

3000th Falcon Car Leaves Factory Line

DETROIT, May 31—In its seventh week of production the Falcon Motors Corp. shipped car No. 3000, according to John A. Nichols, Jr., president. Discussing the present and proposed production schedule, Mr. Nichols declared that the Falcon organization is not interested in establishing high production figures. He said:

"The original policy on which Falcon Motors Corp. was founded will be followed out consistently. High pressure production and sales records often are accomplished by sacrificing quality and reputation of product, as well as profits and stability to the dealer organization.

Mr. Nichols said the Falcon dealer organization is now almost completed in the major automobile markets, and estimated that at the rate new dealer agreements are being written, the entire market will be covered by July 1. Each week retail sales have shown an increase of about 25 per cent over the preceding week.

Elcar Enjoys Record Month

ELKHART, IND., May 28—This month marks the biggest manufacturing and sales schedule for the Elcar Motor Co. since the advent of its new chassis. Since April 1, there have been 38 new distributors and dealers signed. R. A. Rawson, sales manager, has just completed the second of his 1000 mile trips by railroad, automobile and airplane since the big shows, holding meetings with dealer organizations in the east and middle west.

Hudson Schedules 25,000

DETROIT, May 31—To rearrange and expand its facilities for a larger production of Hudson-Essex cars, the Hudson Motor Car Co. will curtail its manufacturing schedules early in June. The period of curtailment will be brief and at no time will manufacturing be suspended entirely. The enlargement of the manufacturing facilities is in response to the demand for cars, which this spring has been much larger than could be supplied. Despite the curtailment, June production will be around 25,000 cars.

Chevrolet Promotes Sales Executives

Grant Names Klingler General Sales Head and Advances Zone Managers

DETROIT, May 28—R. H. Grant, vice-president in charge of sales of the Chevrolet Motor Co., announced this week the appointment of H. J. Klingler as general sales manager of the Chevrolet company. He also made known that M. D. Douglas has been appointed assistant general sales manager for the eastern district and R. E. Ralston, assistant general sales manager in charge of the western district. Both men will make their headquarters in Detroit.

In keeping with Chevrolet's rapid expansion program, Mr. Grant also announced the establishment of several new zones and a number of personnel changes made necessary by promotions all along the line. Chevrolet during the past two years has practically doubled the number of sales zones, Mr. Grant declared. The company now has 41 zones and two more will be added when further plans are completed by Aug. 1.

Mr. Klingler has been associated with Mr. Grant in sales work for eight years. He was first connected with the Delco Light Co. at Dayton and later became zone sales manager for Chevrolet at St. Louis from where he was promoted to assistant general sales manager a year ago. Mr. Douglas has been in the Chevrolet sales organization since 1915 and Mr. Ralston since 1919, both men having worked their way up through the various sales positions to become assistant general sales managers.

Regional Managers Change

A. F. Young, sales manager of the Flint region, goes to Norwood, O., to become sales manager of the southeastern region, succeeding Mr. Douglas. A. W. Gilpin, formerly of the Detroit office, becomes sales manager of the midwest region with headquarters at St. Louis, succeeding Mr. Ralston.

J. C. Chick, formerly zone sales manager at Boston, succeeds Mr. Young in charge of the Flint region. H. J. Walsh, formerly zone sales manager at Buffalo, replaces Mr. Chick at Boston. L. I. Stewart, formerly zone sales manager at Pittsburgh, goes to Buffalo and is succeeded as sales manager at Pittsburgh by W. E. Holler, formerly of the St. Louis region. G. I. Smith, formerly regional sales promotion manager at Cincinnati, becomes sales manager of the newly created zone at Charleston, and E. A. Nimnicht, formerly sales promotion manager at St. Louis, becomes regional manager at the newly created zone at Wichita.

Paul Seese, formerly zone sales manager at Fargo, becomes zone manager at Kansas City and T. F. Kinman, formerly assistant zone manager at Omaha, becomes zone sale sales manager at Fargo.

Mr. Grant stated that the rearrangement of the Chevrolet sales organization would mean that Mr. Klingler will devote his time to sales administration and will enable Mr. Grant to have more time to formulate policies and keep in even closer touch with conditions in the field.

Plasterer Fails to Make Car Plea Stick

MILWAUKEE, May 28—An interesting ruling by Federal Judge F. A. Geiger at Milwaukee has been handed down in the case of A. P. Hess of Kenosha, Wis., a journeyman plasterer, who had gone into bankruptcy and claimed as an exemption his automobile. The exemption was denied.

Hess sought to take advantage of the section of the bankruptcy law which provides that a bankrupt may retain a team of horses or mules, or a motor car worth not more than $400. He claimed that his car was necessary for taking him from job to job.

Canada G.M. Builds 34,304 in 4 Months

OSHAWA, ONT., June 1—The greatest month in the history of General Motors of Canada, Ltd., was experienced during April, when the total output of all makes of cars in the Oshawa plants was 10,916, as compared with 6289 cars in the same month last year. For the first four months of the current year a total of 34,304 was produced as against 20,579 in the corresponding period of 1926.

Announcement has been made by Gordon Lefebvre, general manager, of two new units to be added immediately to the company's already large group of buildings at Oshawa. One of these is a new office building, costing about $375,000, the other a stamping plant of large proportions which with equipment will cost approximately $600,000.

G.M. Adds More Offices

NEW YORK, May 28—General Motors Corp. has leased additional space in the General Motors Building, to which the executive offices were recently moved. The corporation took over the 12th floor and large additional space on the second floor, making a total of more than 14 floors occupied. H. A. Fisher represented the corporation in the negotiations.

New Payment Plan Offered in London

Cars Are Delivered on Receipt of First of 12 Regular Instalments

LONDON, May 17 *(by mail)*—A new move for this country is indicated by the recent announcement of three prominent London dealers (including two big department stores) that they are prepared to supply any make or model of car by 12 monthly instalments without the usual payment down of a lump sum —termed a "deposit" in England— representing 20 to 30 per cent of the list price of the car. The first monthly payment secures delivery.

One of these firms, Whiteleys, the "Universal Providers," who actually led the way in this country many years ago in being the first firm to offer cars on time payments, charge 5 per cent extra and offer every buyer free driving tuition if required. The Morris Cowley four-passenger with front brakes with a list price of £177 is thus offered for twelve instalments of £15. 10s.

Whether or not this move will be follower universally in London and elsewhere in the country remains to be seen, but it is widely expected that dealers in general will have their hands forced in this direction in due course.

Department of Commerce Adds Automotive Aides

WASHINGTON, May 31—The U. S. Department of Commerce has appointed five trade commissioners and one assistant trade commissioner to augment its staff already in the field and to concentrate on automotive and transportation problems, in an effort to assist American industry in being well-informed on transportation conditions in foreign countries.

The commissioners will be sent to Paris, Oslo, Buenos Aires, Wellington and Calcutta. One commissioner is to be assigned to Latin America to handle aviation transport problems.

Rubber Imports 145,079 Tons

WASHINGTON, June 1—The United States during April reexported 3,528,613 lbs., or 1575 long tons, of crude rubber, valued at $1,428,425, it was announced by the rubber division of the U. S. Department of Commerce. Gross imports for April were 46,202 long tons, making net imports over exports for the month 44,627 long tons. Net imports for the first four months of 1927 totaled 145,079 long tons.

Canada Body Builds

TILBURY, ONT., May 31—Work was started this week on a $50,000 addition, 80 x 6, to the factory of the Canadian Auto & Body Co.

New Steel Orders Bring Higher Price

Concessions Declared Readily Obtainable, However, from Recently Advanced Scale

NEW YORK, June 2—The steel price situation has undergone no marked change. If the old price on black sheets is taken as a basis it may be said that somewhat better prices are now being obtained by sellers on what little business is being placed. If market conditions are appraised in the light of the recently announced advance, the ease with which buyers are able to obtain concessions of $1 @ $2 per ton can not be ignored.

The new 4.25 cent quotation for full-finished automobile sheets is still nominal, virtually all present shipments being made at 4.15 cents. No representative amount of new business has been placed so far, so that the price that will apply on motor car manufacturers' third quarter requirements is still problematical. The market for sheet bars, which have sold at around $33.50 lately, will very likely be used as a means of strengthening the sheet market. There is talk of jacking the price to non-integrated sheet rollers for their semi-finished material requirements over the third quarter up to $35.

The steel bar market is ragged. The automotive alloy steel market is steady, however, business moving along routine lines. A good deal of carbon and high-speed tool steel is finding its way into automotive equipment.

While Monday's holiday was responsible to some extent for the slowing down in market activities, seasonal tapering off in the steel demand generally is also in evidence. Steel company sales managers express confidence, however, that the second half of June will bring out a good demand for the third quarter requirements of automotive consumers.

Pig Iron Movement Slow

Pig Iron—Automotive foundries buy from hand to mouth, there being little incentive to anticipating requirements in the present market.

Aluminum—Although prices for virgin ingots remain pegged at unchanged levels, the market's tone is adversely affected by the weakness in copper. Bonded warehouse stocks also continue high, having exceeded 5,000,000 lb. on April 1, about three times what they were on that day last year. Fresh import arrivals are light but, in view of the heavy stocks, the fact that additional supplies are coming in at all adds to the market's easy condition. Detroit demand for remelted metal, which was quite brisk in April and early in May, has slowed down and secondary metal interests have suspended scrap purchases.

Copper—Reductions by the leading interest in prices of all of its rolling and wire mill brass and copper products, corresponding to recent declines in the market for the raw metal, have attracted the attention of foresighted buyers. The copper market is now believed to have struck bottom and even a very slight upward movement would inevitably bring in its train immediate advances in automotive brasses.

Tin—The market is dull and easy.

Lead—Consumers act timid but producers express themselves as confident of a quicker pace in the demand from now on.

Zinc—The market is dull, but relatively steady.

Flood Brings Rise in Hardwood Prices

ATLANTA, May 31—Interviews the last of May with lumber wholesalers in the Atlanta market indicate that while the automobile, commercial body and truck manufacturers are still purchasing hardwood on an excellent basis they are not placing as many advance orders as they were a few weeks ago. Prices recently have been showing a rather steady increase due to lack of production in the Mississippi Valley territory where few of the mills are able to operate because of the flood. This has resulted in a shortage of stock, sending prices steadily upward. It is not believed that the high price mark has yet been reached.

Hardwood sales to the automotive industries during May were better than normal for that month, fully as large as they were in the May of 1926, but due to the fact that sales the first four months of the year were not overly brisk, business for the first five months has been less than usual. The outlook, however, is for at least a normal demand during the spring and summer season, in spite of the high prices prevailing.

N.A.C.C. Names Speakers for Service Discussions

NEW YORK, June 1—Speakers at the Factory Service Managers Forum to be held by the National Automobile Chamber of Commerce at Cleveland, June 14 and 15, will be E. S. Jordan, president Jordan Motor Car Co., P. L. Emerson, vice-president Yellow Truck & Coach Mfg. Co., Percy Chamberlain, assistant director of the Greater Market Development Bureau of the Automotive Equipment Association, John Younger, Ohio State University; Z. D. Dunlap, Durant Motors, Inc., and Earl Turner, general manager of the Automotive Electric Association. H. M. Jewett, chairman of the service committee of the chamber, will preside.

Factories are inviting the attendance of their branch and distributor service managers and invitations are also being extended to the Cleveland Section of the Society of Automotive Engineers, the Automotive Electric Association and the Cleveland Automobile Manufacturers & Dealers Association.

Trindl Increases Capital

CHICAGO, June 1—The title of the Trindl Co. has been changed to the Trindl Corp., the new organization having a capital stock of $1,250,000.

States to Continue Device Regulation

Weights and Measures Conference Agrees Present Supervision Most Satisfactory

WASHINGTON, June 2—The growing automobile industry and the increasing burdens which it is placing on the shoulders of weights and measures officials in all parts of the country consumed a major portion of the time of the delegates to the National Conference on Weights and Measures, composed of state, county and city weights and measures officials, in session at the U. S. Bureau of Standards this week.

Gasoline measuring devices and pumps, methods of measuring automobile oils and greases sold at filling stations, taxicab meters and automobile truck scales were given particular attention by the 250 delegates.

An entire day was devoted to safeguarding the interests of the public in the sale of motor vehicle fuels, oils and greases. It was agreed by the delegates that state rights must be continued and maintained in the regulation of such weights and measures and sealers and inspectors must be allowed to either approve or reject devices for measuring gasoline, oil and grease.

The conference was asked to take under consideration the adoption of a standard type of transmission gear driven taxicab meter to replace the present front wheel type of drive. J. W. Weibley, of the Pittsburgh Taximeter Co., declared that the transmission drive would discourage drivers who attempt to overcharge passengers by tampering with the meter drive arrangement. Letters from various cab companies were presented advocating adoption of the transmission drive.

Harry M. Roeser, of the Bureau of Standards, described a new apparatus for the proper testing of scales for the weighing of motor trucks.

N.S.P.A. Committees to Meet in Cleveland

DETROIT, May 31—The National Standard Parts Association will hold the mid-summer meeting of its membership and merchandising committees at the Hollenbeck Hotel, Cleveland, June 20, followed by a meeting of the board of directors on June 21.

The Cleveland meeting is to give executives an opportunity to make a survey of the show facilities preparatory to making final arrangements for the N. S. P. A. show which will be held in the Cleveland Auditorium the week of Nov. 14.

According to E. P. Chalfant, executive vice-president of the association, the N. S. P. A. has 20 new applications for membership to be considered.

Exports, Imports and Reimports of the Automotive Industry for April of Current Year and Total for Four Months Including April, 1927

	Month of April				Four Months Ending April			
	1926		1927		1926		1927	
	Number	Value	Number	Value	Number	Value	Number	Value
Automobiles, parts and accessories	..	33,000,222	..	$44,317,096	..	$120,617,367	..	$142,213,565
Electric trucks and passenger cars	7	6,070	4	5,277	23	36,464	36	47,213
Motor trucks and buses, except electric	..	..	..	..	..	..	..	..
Up to 1 ton, inclusive	6,511	2,988,589	10,371	4,495,186	19,658	9,152,327	31,087	13,957,917
Over 1 and up to 2½ tons	1,186	1,616,379	1,290	1,713,499	4,287	5,646,514	5,429	6,766,531
Over 2½ tons	240	710,115	202	564,343	784	2,435,286	817	2,425,463
Total motor trucks and buses, except electric	8,037	5,315,083	11,863	6,773,028	24,729	17,234,127	37,333	23,149,911
PASSENGER CARS								
Passenger cars, except electric:								
Value up to $500, inclusive	9,235	3,458,248	7,931	2,776,876	39,512	14,695,356	32,499	12,100,074
Value over $500 to $800	6,527	4,454,098	11,794	6,456,256	2[illegible]340	15,436,865	34,439	20,365,386
Value over $800 to $1,200	5,759	6,109,262	9,853	8,425,441	20,925	22,234,547	28,163	25,304,835
Value over $1,200 to $2,000	1,067	1,654,615	4,241	5,353,283	4,285	6,513,741	10,228	13,095,128
Over $2,000	564	1,533,062	1,021	2,407,643	1,890	5,158,513	2,973	7,445,641
Total passenger cars, except electric	23,152	17,209,285	34,840	25,419,499	88,952	64,039,022	108,302	78,311,064
PARTS, ETC.								
Parts, except engines and tires	..	..	..	..	..	..	..	..
Automobile unit assemblies	..	4,353,371	..	5,307,514	..	17,784,479	..	17,793,692
Automobile parts for replacement	..	3,609,302	..	4,397,384	..	12,393,593	..	15,269,292
Automobile accessories	..	904,116	..	823,613	..	3,387,078	..	2,909,144
Automobile service appliances (n. e. s.)	..	800,144	..	647,310	..	2,260,857	..	2,733,380
Station and warehouse motor trucks	16	15,801	73	19,916	55	39,273	119	65,024
Trailers	78	46,413	93	47,120	505	165,469	378	158,831
Airplanes, seaplanes and other aircraft	..	..	9	179,275	6	35,138	14	263,851
Parts of airplanes, except engines and tires	..	16,679	..	15,233	..	66,481	..	99,043
BICYCLES, ETC.								
Bicycles and tricycles	667	18,294	425	11,249	1,715	49,673	1,655	47,147
Motorcycles	2,205	477,136	2,420	561,227	9,833	2,132,506	7,792	1,758,924
Parts and accessories, except tires	..	141,024	..	118,442	..	647,017	..	469,253
INTERNAL COMBUSTION ENGINES Stationary and Portable								
Diesel and Semi-Diesel	108	148,826	142	113,762	292	534,495	255	420,682
Other stationary and portable:								
Not over 10 HP.	2,917	245,557	2,768	221,400	9,891	871,025	9,821	834,728
Over 10 HP.	136	164,324	163	179,067	689	643,991	495	465,693
Automobile engines for:								
Motor trucks and buses	697	87,124	532	66,266	1,792	217,359	2,028	216,590
Passenger cars	17,385	1,515,871	11,996	1,524,515	60,008	5,525,245	35,614	4,516,659
Tractors	117	85,235	461	178,565	385	251,497	713	333,696
Aircraft	106	39,439	4	15,268	142	141,707	15	81,219
Accessories and parts (carburetors)	..	428,499	..	298,161	..	1,419,331	..	1,414,009
IMPORTS								
Automobiles and chassis (dutiable)	67	132,119	44	111,352	232	404,878	149	289,734
Other vehicles and parts for them (dutiable)	..	20,782	..	44,596	..	32,375	..	75,327
REIMPORTS								
Automobiles (free from duty)	6	2,025	12	23,507	40	56,318	54	107,068

U.S. Takes Lead as Tire Exporter

WASHINGTON, May 28—A 50 per cent increase in the automobile tire casing exports from the four leading manufacturing countries is reported for the first quarter of 1927 by the rubber division of the U. S. Department of Commerce.

The United States assumed the leading position, supplying about 33 per cent of the total. France was reduced to second place, supplying about 31 per cent; Canada furnished 23 per cent, and the United Kingdom, 13 per cent.

In the first quarter of 1926 the United States supplied 30 per cent; France, 35 per cent; Canada, 22 per cent, and the United Kingdom 13 per cent.

Exports of casings from this country during the past quarter totaled 706,574 units, as compared with 418,287 during the first quarter last year. Total exports of the four countries during the past quarter were 2,100,000 units.

Sweden Has New Four

WASHINGTON, May 28—A new four-cylinder car known as the "Violve" has been placed on the market in Sweden, the U. S. Department of Commerce was informed. The prices range from $1,286 for the touring to $1,554 for the closed model. The manufacturers intend to compete on a large scale in the European market.

The engine is of approximately 118 cu. in displacement, the cylinders being 2 15/16 in. by 4 1-3 in. At 2000 r.p.m. the engine develops a brake horsepower of 28, giving a road speed of about 36 miles per hour. The new car has accessories similar to American cars of the same price class.

Importers Add to Stocks Against French Duty Rise

PARIS, May 14 (*by mail*)—While considerable opposition is being raised in numerous political circles against the proposed French protectionist tariff which will have the effect of very considerably increasing the duty on low-priced automobiles, there is an impression that the bill will go through Parliament without any important changes. American importers are alarmed at the outlook and in most cases are endeavoring to relieve the immediate adverse effects of the measure by bringing in as big stocks as possible.

Germany to Stage Races

BERLIN, May 20 (*by mail*)—Germany's great new racing track, the Nuerburg Ring, will be opened for the first time to racing June 18 and 19, and the Allgemeine Deutsche Automobil Club has organized a number of races to take place on those days. They will be open events and include two races for motorcycles and sidecars, one race for sports cars and one for racing cars.

Industry's Exports Establish New High

WASHINGTON, May 31—Exports of passenger cars and trucks from the United States in April set a new month's record, with a total of 34,840 passenger cars and 11,863 trucks, the automotive division of the U. S. Department of Commerce announced, in a set of revised export figures.

This represents a total value of $46,168,743, or an increase of 16.8 per cent over exports for March and 14.5 per cent over exports for April, 1926.

The previous month's record for passenger car exports was set in March, when 29,985 were shipped and the record for trucks in February, when 10,120 were exported. The export figures for April, 1926, were 23,152 passenger cars and 8037 trucks.

The ratio of passenger car exports to production was 9.9 per cent in April, as compared with 8.8 per cent in March and 6 per cent in April of last year. The truck ratio of exports to production in April was 26.7 per cent, as compared with 16.9 in March and 17.2 per cent in April, 1926. The total ratio of exports to production of both classes in April was 11.7 per cent.

Reading Chain Moves Office

NEW YORK, May 28—The New York office of the Reading Chain & Block Corp. has been moved to the Park Bldg., 9-15 Park Place. R. E. Nelles is in charge.

Weather Conditions Reduce Sales in May

(Continued from page 878)

Reports from leading centers in the main indicate that May business was under the April totals and that new car stocks have shown a tendency to rise. Used car stocks in many instances are reported in better condition. These reports follow:

NEW YORK

New car sales in the New York territory have been rather dull for the season of year, the total running about 15 per cent under the level of last year at this time and slightly under April of this year. Sherlock & Arnold report that sales up to May 14 in the metropolitan area were 6560 cars against 7664 in the first two weeks of May, 1926, and comparing with 14,818 in the entire month of April this year. Used car stocks are in fairly good condition, especially so far as the metropolitan dealers and distributors are concerned. General business continues good, and instalment financing is on a sound basis.

BOSTON

Boston automobile dealers are still optimistic, but they would like to see more activity on the part of buyers of new and used cars. Day after day they have looked out upon rain, particularly on business days. May had been expected to run up the totals more but in a number of cases the increase has been from 5 to 10 per cent, with others falling behind, so the general average for the month may not break even with a year ago. Used cars are moving about on a par with the new cars. Stricter terms of finance companies because of bank curtailment is another factor. Dealers now are going on the basis that only the hardest kind of work will net them 75 or 80 per cent of the sales for 1926 up to October.

ATLANTA

Though the past month has witnessed a fair improvement in the automobile demand in the southeastern district, distributors state that sales are not normal, considering the district as a whole. Nearly all motor cars are selling normally in the larger cities but there is much less than normal call for cars in the smaller towns and rural communities. However, this condition gives promise of early improvement because of the steady advance in cotton prices the past five or six weeks.

DALLAS

Automotive trade in Texas and parts of Oklahoma, Louisiana, New Mexico and Arizona went into the sixth month of the year showing more signs of life than had been evident for six weeks.

Retail sales of automobiles during May showed an increase of 5 per cent over the preceding month. Low and medium priced sixes led the field. Used car sales were also 5 per cent better than for April. Most sales were on thoroughly reconditioned machines and the majority of deals involved trades and instalment payments. Dealers have pretty heavy stocks and prices are low.

Truck sales showed some improvement, especially in the grain belts.

NEW ORLEANS

A survey of the automotive industry in New Orleans for May shows the industry has suffered heavily as a result of the flooding of the Mississippi Valley, and the general apprehension for the safety of the city.

From May 1 to May 15 the sale of new automobiles was practically nil, but as a result of a magnificent show sponsored and staged by the Times Picayune, and also favorable reports with respect to the safety of the city made by state and national engineers, marked improvement was shown during the latter part of the month.

Due to the large amount of truck equipment used in the strengthening of the levees, as well as the evacuation of territories inundated by both artificial and natural crevasses, this phase of the industry has shown but slight depression.

The used car market apparently has suffered tremendously. There is a heavy accumulation now on the market, and unless the situation improves rapidly, many dealers will be forced to turn their used cars at a heavy loss.

ST. LOUIS

Retail automobile sales have been dull during the past month and it is expected that this condition will continue for some time. The great area to the south which composes a large part of this city's trade territory has been badly affected by the flood and it will be some time before conditions permit normal buying. Automobile men feel that the motor car industry here will earn little money this summer and that it will be September or October before sales approach their normal volume.

CHICAGO

Automobile business in May was disappointing to many dealers in Chicago. Dealers lay the blame upon general conditions and unfavorable weather marking a number of days in May. New car sales in Illinois are running about 20 per cent behind the pace of last year to this time. Used cars have moved in greater volume recently but stocks still are large in numerous instances and there is more price cutting. A tapering off of new car sales is expected in June.

MILWAUKEE

Passenger car sales were handicapped by several adverse influences but prospects for June are regarded as encouraging. May was one of the wettest months in Milwaukee and Wisconsin history, and this was one cause for a substantial reduction in total new car sales from the record established in May, 1926, when 21,093 cars were sold. The state of business generally is quiet but has brightened.

SEATTLE

Sales in the Seattle district between Jan. 1 and May 30 will be approximately 30 per cent under sales for the same period of 1926, due largely to a poor January and February. Sales began to pick up in Seattle and the Pacific Northwest generally in March; April was a little better, and May has been up to May of last year. Distributors apparently have plenty of new cars on hand for their own retail departments and for dealers in the Puget Sound area. Spring weather brought a burst of used car buying.

DETROIT

Reports gathered from various state points indicate that automobile dealers in Michigan enjoyed a satisfactory May business. Spring sales have shown a marked demand for cars in the lower priced groups. New car stocks in dealer's hands are at a satisfactory level while used car stocks have been gradually reduced.

CLEVELAND

New car sales bigger for the month of May and indicate the present automobile market a low priced one. Manufacturers producing medium priced cars are doing a healthy volume of business. Makers of more expensive models are finding it a tough job to get going. Altogether, May has been an in and out sales month with one week giving indication of breaking records and the ensuing week showing a heavy slump.

DENVER

Automobile sales increased in Denver and vicinity in May. Dealers report the heaviest business of any May since they have been in business. Heaviest buying has been in medium priced cars. The used car situation in Denver is satisfactory, due principally to the cooperation of members of the association through their subsidiary used car association. Dealers outside of the city report average business in the farming territory, and very good prospects due to a promising potato and beet crop.

LOS ANGELES

Southern California May sales fell below May last year and slightly under April. Sales reflect quiet business generally. Used cars moving reasonably well, but stocks somewhat heavier. The truck market continues slow, with sales considerably under May last year, and about even with April.

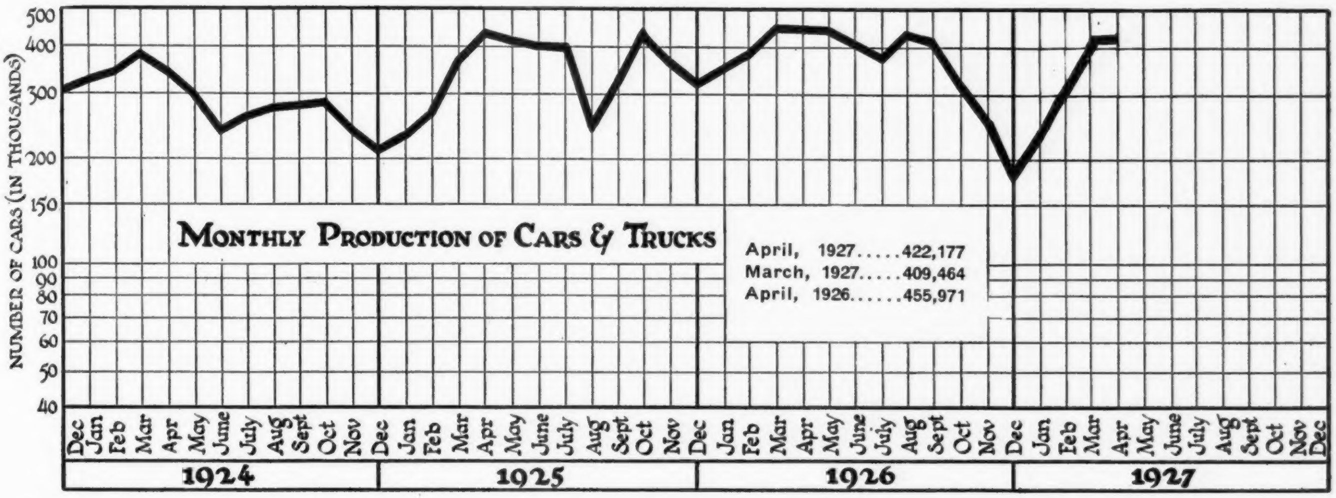
SAN FRANCISCO

Sales in northern and central California for May showed improvement of about 15 per cent over those of April and 10 per cent over those of May a year ago. Used cars selling under $500 are moving better than any time during past year. Higher priced used cars moving slowly. General business conditions are good. Used trucks are in demand and new trucks of small sizes selling better than May, last year.

KANSAS CITY

The outstanding feature of the motor car situation in Kansas City in May is the heavy sale of used cars. While new car sales have been somewhat above last year, dealers have cleaned up on used models. May sales are reported by most dealers as from 15 to 60 per cent better than April and about 10 to 25 per cent over last year.

April Output Continues Upward Trend



Auburn Adds Cabriolets Priced $1,295 to $2,095

AUBURN, IND., May 28—Auburn Automobile Co. has started production on a new cabriolet model which it will build on all three chassis models. The price on the 6-66 model will be $1,295, on the 8-77, $1,595, and on the 8-88 $2,095. With rumble seat the car has accommodations for two or three extra passengers.

The upholstery is leather. The front seat has a dividing arm rest that fits flush into the back cushion when folded back. Colors on the 6-66 are the standard moleskin and Russian brown combination. On the 8-77 a two-tone blue combination is offered, and on the 8-88 a fawn and beaver brown.

Auto Spring Changes Name

JAMESTOWN, N. Y., May 28—The Auto Spring Control Co., manufacturer of the Two-Way hydraulic shock absorber and hydraulic shimmy killer, has taken steps to change the name of its organization to the Two-Way Shock Absorber Co. and has increased its capital stock from $200,000 to $500,000; the stockholders at a recent meeting having voted in favor of the above changes.

Graham Output Jumped

EVANSVILLE, IND., May 28—Daily production at the Graham Brothers truck division plant of Dodge Brothers, Inc., has been jumped from 50 cars and 225 bodies to 60 cars and 300 bodies to meet demand of late spring and summer season, A. E. Cooney, general manager, announced.

Manufacturers Aid Students

RACINE, May 28—Henry T. Vance, son of Louis T. Vance, general manager of the Racine Rubber Co. and in charge of the Racine division of the Ajax Rubber Co., has recently completed an interesting study in connection with the research department of the Wharton School of Finance and Commerce at the University of Pennsylvania. The thesis which is one of the requirements for graduation covers the subject of "Financial Policies of the Ajax Rubber Co." More than 200 manufacturers cooperated with the Wharton school by opening their plants to the students. The average time spent by the students in this research work was eight hours a week for a period of six months.

Postoffice to Buy More Armored Cabs for Trucks

WASHINGTON, May 28—The U. S. Postoffice Department has awarded contracts for 275 armored truck cabs for assembly on trucks now in service and will continue armoring of its trucks during the coming fiscal year, it was announced here this week.

Delivery of the first lot of 25 armored cabs has been completed by George B. Marx, Brooklyn, N. Y., and approximately 60 of 100 ordered from the American Coach & Body Co., Cleveland, have been delivered. An additional contract for 150 cabs has been awarded to the Eddystone Steel Co., Eddystone, Pa., and fabrication is being commenced.

The cabs are being installed on the regular screen-body trucks, most of which are Ford trucks.

French Car Exports Lower

PARIS, May 20 *(by mail)*—French automobile exports totalled 3989 passenger cars and 352 trucks during the month of March, 1927, this being a decrease of 738 vehicles compared with the corresponding month of last year. Spain headed the list of French clients with 878 passenger cars, Great Britain coming second and Switzerland ranking third.

Automobile imports into France during the month of March show 187 passenger cars and 2 trucks, this being a decrease of 103 compared with March, 1926.

978 Driveaways in Day Set New Overland Mark

TOLEDO; May 28—A new record for driveaways was set at the Willys-Overland plant here last Tuesday when 978 cars including all models of Whippets and Willys-Knight were driven away by dealers to supply markets in seven nearby states.

The cars went to the branches of Willys-Overland, Inc., in Chicago, Indianapolis, Pittsburgh, Detroit, Cleveland, Buffalo, Elmira, N. Y., Huntington, W. Va., and Youngstown with many into the territory covered by the big Toledo branch organization.

Improvements in roads are enabling more cars to be delivered by driving away from the factory than in previous years.

Small Car Development Benefits Italian Exports

WASHINGTON, May 28—Steady increases in Italian automobile exports are resulting from the development of smaller and lower priced cars, installation of modern plant equipment and a concerted effort to popularize the Italian product in the foreign markets, according to the Automotive Division, U. S. Department of Commerce.

During 1926 approximately 65,000 cars were produced in Italy, of which 35,000 were exported. Notable gains have been made in the exports to France, Germany, Rumania, India and South Africa.

Build New Polish Car

WASHINGTON, May 28—The Koprivnice Car Co. with a personnel of 2000 employees, has made a wage reduction of 10 per cent and at the same time commenced work on its first series of 300 small "Tatra" automobiles, the U. S. Department of Commerce announced. There are good prospects for the sale of these cars in Hungary and Poland.

Men of the Industry and What They Are Doing

Talcott Chief Engineer of Pierce-Arrow Company

John C. Talcott has been appointed chief engineer of Pierce-Arrow Motor Car Co., succeeding the late Charles Sheppy. He has been associated with the Pierce-Arrow company since his graduation from Cornell University in 1909 and has been chief experimental engineer for the last eight years.

For his work in the refinement of six-cylinder design, Mr. Talcott has gained wide recognition in the engineering fraternity. He was responsible for the experimental development of the dual valve principle, pioneered by Pierce-Arrow, which lifted the efficiency of the six-cylinder engine far beyond former standards.

With Mr. Talcott's appointment, the naming of W. W. Slaght, former assistant experimental engineer to the position of chief experimental engineer, was also announced.

Name New Vice-Presidents

C. C. Chesney, manager of the Pittsfield works; W. R. Burrows, associate manager of the incandescent lamp department, and C. E. Eveleth, manager of the Schenectady works, have been elected vice-presidents of General Electric Co. F. C. Pratt, vice-president in charge of manufacturing, and H. F. T. Erben, assistant vice-president of the manufacturing department, have retired. Other officers of the company were reelected at the annual meeting.

Douthit Heads Indian

Claude Douthit has been elected president of Indian Motocycle Co. and Louis E. Bauer is named chairman of the executive committee and director in active charge of management. Mr. Douthit, who succeeds Frank J. Weschler, has been a director of the company for several years and is one of the largest individual holders of stock.

Heminway Heads Trade Executives

M. L. Heminway, general manager of the Motor & Accessory Manufacturers Association, was elected president of the Trade Association Executives in New York at their annual meeting. This organization comprises 115 managing executives of trade associations with headquarters in the metropolis.

Name New Representatives

H. L. Wilson has been appointed Cleveland representative by the Geuder, Paeschke & Frey Co., Milwaukee. Arthur Dixon and Earl M. Hunker have been appointed representatives in Indiana and Louisville, Ky., territories.

Tjaarda Leaves Locke

J. Tjaarda has resigned as chief designer of Locke & Co. and is leaving for Europe July 1 to accept a position there.

Bean Joins Board of Guy Motors, Ltd.

J. H. Bean, who was formerly managing director of Bean Cars, Ltd. (Harper, Sons & Bean, Ltd.), Dudley, has now resigned from the board of this company and has joined the board of Guy Motors, Ltd., Fallings Park, Wolverhampton.

Prepare for Paris Meeting

Alfred Reeves, general manager of the National Automobile Chamber of Commerce, is sailing for Europe June 8. Roy D. Chapin, president of the chamber, and Windsor T. White, chairman of the motor truck committee, will sail June 10, while John N. Willys, chairman of the foreign trade committee, will follow later. All are to attend the meeting of the Bureau Permanent des Constructeurs d'Automobiles, Paris, June 27-July 2.

Willys Talks to Delegates

A farewell luncheon to the Pan-American Commercial Congress delegates was given by the National Automobile Chamber of Commerce at the Hotel Roosevelt today. John N. Willys, chairman of the association's foreign trade committee, addressed the delegates and short talks were given by Stephen James of the Highway Education Board and by Frederico Adolphus Pezet, former Peruvian Ambassador to the United States.

Winton Heads Advertisers

Howard Winton, general branch manager of the Heil Co., has been elected president of the Milwaukee Association of Industrial Advertisers. Mr. Winton served as advertising manager of the Heil company for eight years. He was recently appointed general branch manager but retains active part in the advertising division.

Mackenzie Joins Acme

W. C. Mackenzie, formerly of the Garford Motor Truck Co., has been appointed chief engineer of the Acme Motor Truck Co. and is in charge of all engineering on both the Acme and United lines. Mr. Mackenzie succeeds Harry Richards who resigned on May 15.

Export Appointments Made

Paul Heinen has been added to the export organization of Chandler-Cleveland Motors Corp., and will have as his territory Great Britain and the European continent generally. H. Allan Kingsley and Tom Stevenson have been named special representatives in the Canadian territory.

White Company Appoints New District Managers

New managers for six districts and branch offices have been appointed by the White Co. R. W. Moore, branch manager at Oakland, Cal., is promoted to district manager at Portland, Ore., succeeding C. B. Lynn, resigned. R. M. Miller, salesman at Oakland, is new branch manager there. Sidney S. Warner has been named district manager at Toledo, and W. J. Miller is named manager at Harrisburg, Pa. B. H. Crowder, formerly of Seattle, is now sales manager at the Pittsburgh office.

C. G. Richardson, Winnipeg branch manager, has been appointed branch manager at Montreal, and C. J. O'Brien, Toronto salesman, is new Winnipeg manager. These appointments were made to permit L. M. Hart, Canadian managing director, to give more attention to developing business for all Canadian branches.

Foster and Ralls Go Abroad

Claude H. Foster, chairman of the board of directors, and George H. Ralls, president of Gabriel Snubber Mfg. Co., sailed last week on an extended business trip through Europe. They plan to be gone about six weeks during which time they will visit Turin, Italy, where Fiat has taken delivery of 10,000 sets of snubbers during 1927 and have just placed an additional order for a like amount.

Adams Conference Chairman

Porter H. Adams, president of the National Aeronautic Association, will serve as chairman of the National Conference for the Development of Commercial Aviation, to be held at St. Joseph, Mo., June 6 and 7, it was announced this week.

Rose Rejoins Willys

John A. Rose has rejoined Willys-Overland, Inc., his duties for the present being confined to special sales work in the domestic field. Mr. Rose was long identified with the company in an export capacity and he is widely known to export executives.

MacLean Vice-President

A. A. MacLean, who has been connected with U. S. Light & Heat Corp. for six years as director of purchases and later as assistant to D. H. Kelly, vice-president, has been elected a vice-president of USL Battery Corp.

Young Milwaukee Chairman

New officers of the Milwaukee Section of the Society of Automotive Engineers are Fred M. Young, chairman; Walter S. Nathan, vice-chairman; George C. Appel, treasurer, and Arthur C. Wollensak, secretary.

Goodyear Outlines New Capital Plans

Will Use New 5 Per Cent Bonds to Retire 8 Per Cent Securities

NEW YORK, May 31—New plans for simplifying the capital structure of the Goodyear Tire & Rubber Co. will be offered to stockholders at the annual meeting called for July 11 by the board of directors at a meeting last week. The stockholders will be asked to consider and approve the following:

The issue of $60,000,000 first mortgage 5 per cent collateral bonds.

The retirement of the existing three 8 per cent securities—first mortgage bonds, debentures and prior preference stock.

Issuance by the Goodyear company of a new class of preferred stock without par value, authorized amount of 1,000,000 shares, bearing dividends at the rate of $7 annually, redeemable at $110, entitled to $110 on voluntary liquidation or dissolution and $100 on involuntary liquidation or dissolution, and to have a sinking fund of 10 per cent of the consolidated net earnings after deducting all charges and income taxes and purchase fund requirements on the $60,000,000 of new bonds and dividends on all preferred stocks. This new preferred will rank ahead of the existing preferred and will have one vote per share in the event of default.

The existing preferred stock is to be exchanged for the new preferred on the basis of one share of the existing preferred for 1¼ shares of new preferred. Such opportunity to exchange is conditional upon the acceptance thereof of such percentage of the existing preferred stockholders as the board of directors shall determine.

125 Cars Leave Factory in Velie's Drive-Away

MOLINE, ILL., May 28—A score of Velie dealers and distributors participated in the annual drive-away from the Velie factory this week and 125 cars formed a procession through the tri-cities before launching on their home trips. Velie dealers from Pittsburgh, Pa., Cincinnati, Chillicothe and Dayton, Ohio, Kansas City, Paterson, N. J., and St. Louis were among the distance drivers.

The Paterson dealer won the $50 gold piece for the "farthest-away" dealer. The Velie-Bell, Chicago, with 27, took the largest group of cars. The dealers were entertained at a luncheon in the plant salesroom and had a group picture taken.

Pierce Heads New Company

NEW YORK, May 28—The Emerol Mfg. Co. has embarked upon the manufacture and sale of Marvel Mystery Oil, a penetrating oil designed for mixture with the oil in the crankcase, and for lubrication in other parts of the car. It is also used to soften carbon and dissolve rust, being especially recommended for new engines and for sticking and carbonized valves. The factories are at Chicago and New York.

Burt N. Pierce, well known in the industry for his development of carburetors, is president of the Emerol company, which recently absorbed the Visible Gas-O-Clean Corp., maker of oil filters.

U. S. Airways to Reach 82 Cities by End of 1927

WASHINGTON, June 1—Issuance by the aeronautics branch of the U. S. Department of Commerce of an illustrated bulletin on Federal Air Traffic Rules brings almost to a close the first year of its official existence.

In its report on progress during this period the branch announces completion of 1386 miles of lighting on civil airways, establishment of 45 intermediate fields, location of 109 beacons and 73 blinker lights between municipal airports and beginning of installation of radio directive beacons at strategic points.

By the end of 1927 it was predicted the airway system of the United States will be increased to 9435 miles, serving 82 cities, with a combined population of almost 24,000,000 persons.

Non-Military Planes Fly 23,000,000 Miles in 1926

WASHINGTON, May 28—More than 23,000,000 miles were flown by civil and commercial aircraft in the United States during 1926 and an additional 37,500 miles by lighter-than-air craft, it was announced by William P. MacCracken, Jr., assistant secretary of Commerce for Aeronautics.

Reports covered flights by 1536 planes. Over 18 regular airways 194 planes maintained a scheduled mileage of 4,474,772 miles in 1926. A total of 94,353 free passengers and 676,567 pay passengers were carried and pay freight amounted to 418,986 lb.

Financial Notes

Paige-Detroit Motor Car Co. has notified New York Stock Exchange that common stock of record May 31 will be offered the right to subscribe, at $100 a share, for 7 per cent cumulative second preferred stock of $100 par, to the extent of one share for each 16.91 shares of common held, and also at $10 a share for no par common stock to the extent of one share for each 1.5972 shares held. New York Stock Exchange committee on securities rules that the common stock shall be quoted ex the rights May 31. The right to subscribe expires June 10.

Rights to subscribe to additional common stock figure out to be worth about $1. Until second preferred stock is traded in, no valuation can be placed on rights to subscribe to this issue.

Westinghouse Electric & Mfg. Co. reports sales for the year ended March 31, 1927, as $185,500,000, an increase of $20,000,000 over 1926, its best previous year. Net income available for dividends was $16,138,441. Current assets total $120,000,000 and current liabilities $18,000,000. Inventories totaled $72,000,000, a reduction of $7,000,000 during the year.

Norwalk Tire & Rubber Co. reports for quarter ended March 31, 1927, net loss of $46,953 after expenses, depreciation, discounts, etc., comparing with net loss of $63,895 in preceding quarter. Net loss for six months ended March 31 totaled $110,848 after the above charges.

Price Reductions Bring Olds Range $875-$1,075

LANSING, June 1—Price reductions on all Oldsmobile models ranging from $50 to $115 have been made effective today by Olds Motor Works. The new and old prices are as follows:

Model	New	Old
2-door sedan	$875	$950
Coupe	875	925
4-door sedan	975	1,025
De Luxe roadster	895	975
De Luxe touring	895	980
Sport coupe	965	1,035
Landau	1,075	1,190

First Ford Car Scared Family, Says Maker as Fifteen Millionth Passes Into History

DETROIT, May 28—Completion of fifteen millionth Model T, observed by Ford Motor Co. this week with the photographing of it with Henry and Edsel Ford and the original Ford car, brought forth reminiscences from Henry Ford on the earlier vehicle.

"I had to make some special tools to make these spokes," he remarked.

"How much did you sell it for?" someone queried.

"Sold it to Charlie Ainslee for $160. He afterwards started the Buffalo Gasoline Engine Works," recalled the motor magnate. "Truman Newberry made the springs, or his company did.

"I recall coming upon a horse and buggy. The whole family got out of the carriage when they saw us. The horse wasn't scared, but the family was."

The first Model T was produced Oct. 1, 1908, and the millionth, Dec. 10, 1915. The ten millionth was manufactured June 4, 1924.

Eight veterans in the Ford organization were given the honor of stamping the numerals on the engine of the fifteen millionth. They were J. F. Wandersee and A. Degener, with Ford since 1902; Frank Kulick, who drove the ten millionth Ford from New York to San Francisco; F. L. Rockleman and P. E. Martin, with Ford since 1903, and C. B. Hartner, C. E. Sorenson and Charles Meida, connected since 1904.

Stage Welding Show With Machine Tools

CLEVELAND, June 1—Under plans of the American Society for Steel Treating, the National Steel & Machine Tool Exposition, to be staged in Detroit the week of Sept. 19, will be the largest of any of its eight previous shows. Over 80,000 of the 90,000 sq. ft. have been reserved to date by 262 exhibitors.

Approximately 10,000 sq. ft. will be devoted to an exhibit of welding material and equipment. This is a new feature of the exposition, the welding exhibition formerly being carried on as an independent showing under the auspices of the American Welding Society. This society will hold its regular fall meeting in Detroit at the same time as the exposition and in place of holding an independent exhibit has combined with the National Steel & Machine Tool Exhibition.

Bus Men Seek Extension

NEW YORK, May 28—The Motor Coach Owners' Board of Trade will appeal to Police Commissioner Warren of New York to modify his recent ruling that interurban and suburban buses will not be allowed to use the streets as terminals after August first.

The bus operators are formulating plans for a bus terminal that will obviate the need for parking in the streets but it will take some time to obtain the necessary facilities.

Erskine Wins Gold Medal

NEW YORK, June 1—An Erskine stock sedan has been awarded the gold medal in the classic London to Land's End reliability run recently held in England according to cables received in this country by the Studebaker Corp. of America. The run was over a distance of 317¼ miles.

Coming Feature Issue of Chilton Class Journal Publications

June 10—Motor World Wholesale—A.E.A. Summer Meeting Number.

Chicago-Dallas Air Line Adds 2 Travelair Planes

KANSAS CITY, May 27—Two giant monoplanes have been brought to Kansas City and will be placed in passenger service on the route of the National Air Transport, Inc., in a short time. The planes were built in Wichita, Kan., by the Travelair Corp. They are powered with Wright Whirlwind motors. The ships have a capacity of eight passengers and the pilot, the passenger cabin being enclosed in glass.

The planes will be put in service between Kansas City, Dallas, Chicago and all points on the Chicago-Dallas air mail route operated by the company, which is headed by Col. Paul Henderson, former assistant postmaster general.

Change Rubber Trading

NEW YORK, May 28—Proposals for changes in the rules of the Rubber Exchange of New York were approved this week and were referred to the rules committee for drafting into form for submission to the board of governors and later for ratification by the membership.

Two of the most important changes approved were increasing the unit of trading from two and one-half to five tons, and an average reduction in the commission rates of 40 per cent.

Lower Prices Cut 1926 Export Total

WASHINGTON, May 28—Exports from the United States in 1926 were valued at $4,713,535,066, as compared with $4,819,041,485 in 1925, or a decrease of $105,488,429, the U. S. Department of Commerce announced. The decrease is attributed largely to lower prices for staple exports such as cotton.

Michigan and Ohio again led all other states in the exporting of automotive products. During the year Michigan manufacturers shipped abroad $115,199,976 worth of passenger cars, $65,049,667 worth of parts, $24,977,220 worth of trucks and buses, $12,877,324 worth of tractors and tractor parts, and $1,804,723 worth of tires. Ohio's tire exports totaled $19,609,734 and its passenger cars $13,593,730.

Towns to Get Safety Awards

BOSTON, May 28—Governor Alvan T. Fuller, of Massachusetts, Packard distributor for eastern New England, has just presented to the Massachusetts Safety Council and allied organizations, three silver cups that will be awarded to the cities and towns that have decreased their motor vehicle deaths and accidents between now and Nov. 1. This was announced yesterday at Worcester where there was a meeting of automobile and safety people from all over the state.

S.A.E. Books Open Session

SAN FRANCISCO, June 1—The Northern California Section of the Society of Automotive Engineers will hold its first annual open meeting and installation of officers, on the roof garden of the Whitcomb Hotel on the night of June 9. Ladies are invited and prizes offered for dancing.

Calendar of Coming Events

SHOWS

Budapest ....June 4-15
Chicago ....Nov. 7-12
Exposition, Coliseum, Automotive Equipment Association.
Chicago ....Jan. 28-Feb. 4
National, Coliseum, National Automobile Chamber of Commerce, including special Shop Equipment Exhibit.
Chicago ....Jan. 28-Feb. 4
Automobile Salon, Hotel Drake.
Cleveland ....Sept. 19-23
Exposition, Public Auditorium, National Machine Tool Builders' Ass'n.
Cleveland ....Oct. 3-7
Exhibition, Public Auditorium, American Electric Railway Ass'n.
Cleveland ....Nov. 14-19
Convention Hall, National Standard Parts Association.
Cleveland ....Jan. 9-14
American Road Builders Association.
London ....Oct. 14-22
Olympia Passenger Car Show.
London ....Nov. 17-26
Olympia Truck Show.
Los Angeles ....Feb. 11-18
Automobile Salon, Hotel Biltmore.
New Haven, Conn. ....Sept. 6-9
Machine Tool Exhibition.
New York ....Nov. 27-Dec. 3
Automobile Salon, Hotel Commodore.
New York ....Jan. 7-14
National, Grand Central Palace, National Automobile Chamber of Commerce, including special Shop Equipment Exhibit.
Paris ....Oct. 6-16
Grand Palais.
Prague ....June 4-16
International Aeronautical Exhibition.
San Francisco ....Feb. 25-March 3
Automobile Salon, Hotel St. Francis.

CONVENTIONS

American Automobile Association, Bus Division Meeting, Ritz-Carlton, Philadelphia ....June 15-16
American Automobile Association, Annual Meeting, Ritz-Carlton Hotel, Philadelphia ....June 16-17
American Electric Railway Association, Public Auditorium, Cleveland..Oct. 3-7
American Society for Steel Treating, Convention Hall, Detroit....Sept. 19-24
American Society for Testing Materials, French Lick Springs, Ind....June 20-24
Automotive Equipment Association Summer Convention, Multnomah Hotel, Portland, Ore...June 27-July 2
Automotive Equipment Association, Coliseum, Chicago ....Nov. 7-12
Bureau Permanent, Paris ....June 18
International Chamber of Commerce, Stockholm ....June 27-July 2
National Association of Automobile Show and Association Managers, Drake Hotel, Chicago ....July 28-29
National Association of Credit Men, Brown Hotel, Louisville, Ky...June 6-10
National Safety Council, Stevens Hotel, Chicago ....Sept. 26-30
National Standard Parts Association, Hotel Hollenden, Cleveland..Nov. 14-19
United States Good Roads Association, Savannah, Ga. ....June 6-11

N. A. C. C.

Cleveland, June 14-15—Factory Service Managers Forum, Hotel Statler.

S. A. E.

National

Chicago, November—National Transportation and Service Meeting.
Chicago, Dec. 1—Tractor Meeting.
Cleveland and Detroit, Sept. 19-22—Production Meeting.

RACES

Abilene, Texas ....July 4
Altoona, Pa. ....June 11
Altoona, Pa. ....Sept. 5
Atlantic City ....Sept. 24
Belgian Grand Prix, Spa-Francorchamps ....July 9-10
British Grand Prix, Brooklands......Oct. 1
Charlotte, N. C. ....Oct.
Detroit ....Sept. 10
French Grand Prix, Montlhery......July 3
Los Angeles ....Nov. 27
Salem, N. H. ....June 25
Salem, N. H. ....Oct. 12
Syracuse, N. Y. ....Sept. 3